ICES WGITMO REPORT 2016

SCICOM STEERING GROUP ON ECOSYSTEM PRESSURES AND IMPACTS

ICES CM 2016/SSGEPI:10

REF. ACOM, SCICOM

Report of the Working Group on Introductions and Transfers of Marine Organisms (WGITMO)

16–18 March 2016

Olbia, Italy

ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES. 2016. Report of the Working Group on Introductions and Transfers of Marine Organisms (WGITMO), 16–18 March 2016, Olbia, Italy. ICES CM 2016/SSGEPI:10. 201 pp.

Contents

Executive summary

The 42nd meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO) was held in Olbia, Italy, 16–18 March 2016, with Anna Occhipinti-Ambrogi as host and Henn Ojaveer as chairperson. Representatives from 19 countries participated in the meeting. Attendants were from Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Ireland, Israel, Italy, Lithuania, Norway, Poland, Portugal, Russia, Spain, Sweden, United Kingdom and United States. Sweden contributed by correspondence.

The objectives of the meeting were to update information and discuss several aspects related to the introductions and transfers of non-indigenous aquatic species. Data and information management were two of the discussion topics of the meeting, with special focus on the better exploitation of the 'Information system on aquatic non-indigenous and cryptogenic species' (AquaNIS). The WGITMO also dedicated time for addressing the MSFD D2 issues: indicator on new non-indigenous species introduced by human activities, and opportunities and problems related to cross-regional comparison of non-indigenous species indicators. Preparation of the manuscript of the alert report on sea squirt *Didemnum vexillum,* which is to be published in ICES CRR series, was discussed and the steps to be taken to finalise the report were agreed. As usual, adequate time was devoted to discuss national reports, to exchange of information on the management of NIS and to review ongoing and planned research activities.

The approach taken during the meeting facilitated presentations and discussions on the issues of relevance related to the Terms of References as well as on a few generic and strategically-important issues of general relevance to bioinvasions. The meeting began with a full-day joint meeting with the Working Group on Ballast and Other Ship Vectors (WGBOSV), which provided an opportunity to discuss and address issues of common interest, such as shipping and biofouling as introduction vectors. The proposed ICES demonstration advice on 'Risk management of non-indigenous species associated with shipping in the Arctic' was discussed, and edits were suggested for both the orientation of the demonstration advice as well as for the exact questions to be asked. Both working groups agreed that the practice of conducting back-to-back meetings with one joint day is useful and will continue in 2017.

All Terms of References to be addressed for 2016 were discussed. For some Terms of Reference, more detailed presentations were given, and a short overview of the information and subsequent discussion is provided herein at the end of each section. This report is structured so that each Term of Reference is dealt with in sequential order. The main body of the report contains summaries of the presentations and discussions with the more detailed documents being contained in the Annexes.

WGITMO progressed each of the Terms of Reference by either completing the task or clearly identifying and agreeing on the inter-sessional activities required to still finalise the work in 2016. From 2017, WGITMO will be shifted to multi-annual management.

1 Opening of the meeting

The WGITMO meeting was open at 09:00 on 16 March 2016 as a joint session with the ICES/IOC/IMO Working Group on Ballast Water and Other Ship Vectors (WGBOSV). Sarah Bailey (WGBOSV Chair) and Henn Ojaveer (WGITMO Chair) welcomed all participants. Anna Occhipinti-Ambrogi (Italy) acted as host of the meeting. Sarah Bailey and Henn Ojaveer co-chaired the joint session. This joint session concluded the same day at 17:00, and the WGITMO meeting continued on 17–18 March 2016.

2 Adoption of the agenda

The agenda was organized according to the Terms of Reference provided in the ICES Resolution 2015/2/SSGEPI06 (see below). In addition, invited presentations on a specific topic and/or of generic interest were accommodated into the agenda to foster discussions on potential ToR's for the coming years (Annex 2).

3 WGITMO Terms of Reference

Working Group on Introduction and Transfers of Marine Organisms (WGITMO)

2015/2/SSGEPI06 The **ICES Working Group on Introductions and Transfers of Marine Organisms** (WGITMO), chaired by Henn Ojaveer, Estonia, will meet in Olbia, Italy, 16–18 March 2016, back-to-back with the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) to:

a) Summarize information provided in national reports and through the AquaNIS information system. Develop annual summaries of new occurrences/introductions of aquatic non-indigenous species (NIS);

b) Continue addressing EU MSFD D2 on further developing and evaluating NIS indicators and screening and identification of species of concern;

c) Continue identification and evaluation of climate change impacts on the establishment and spread of NIS. Finalise global review on salinity change effects on non-indigenous species;

d) Continue investigating NIS associated with biofouling, incl. those on artificial hard structures in the marine environment and recreational boating;

e) Finalise draft of the alien species alert report for ICES CRR on *Didemnum vexillum*.

f) Evaluate the role/importance of different bioinvasion vectors and pathways globally.

WGITMO will report by 10 April 2016 (via SSGEPI) for the attention of SCICOM.

Supporting information

Priority:	The work of the Group forms scientific basis for developing options to minimise the risk of future unintentional movements of invasive and/or deleterious aquatic

	species including disease agents and parasites with the legitimate trade in species required for aquaculture, table market, ornamental trade, fishing and other purposes and to assess the potential of species moved intentionally to become a nuisance in the area of introduction. The work of this Group supports the core role of ICES in relation to planned introductions and transfers of organisms.
Justification of venue (in a non-ICES member country)	As marine bioinvasions and their management is a global issue, WGBOSV/WGITMO are continuously aiming to enhance connections with scientists from non-ICES area from various regions and seas globally. In order to continue strenghtening cooperation with the Mediterranean Sea scientists, who annually participate in WGITMO meetings, and to fulfil MoU between ICES and CIESM, WGBOSV/WGITMO will meet in 2016 in Italy.
Scientific justification and relation to action plan:	WGITMO work contributes to the following objectives of EPI: *Estimate long-term trends of human impacts on marine ecosystems:* Develop historical baselines of population and community structure and production to be used as the basis for population and system level reference points *Understand, quantify and mitigate multiple impacts of human activity on populations and ecosystems:* Develop methods to quantify multiple direct and indirect impacts, particularly from fisheries, as well as mineral extraction, energy generation, aquaculture practices and others, and estimate the vul-nerability of marine ecosystems to these impacts. Develop indicators of pressure on populations and ecosystems from human threats such as eutrophication, contaminant and litter release, introduction of invasive species and generation of underwater noise. *Provide evidence in support of the sustainable management of ecosystem goods and services:* Quantify and map biological, ecological and environmental value, optimise ecosystem use and minimise environmental impact, in relation to a dynamic ecosystem carrying capacity. Develop science in support of advisory needs on sustainable marine aquaculture systems, minimising environmental impacts and inte-grating other marine sectors.
Resource requirements:	None required other than those provided by ICES Secretariat and national members
Participants:	WGITMO nominated members and invited experts from, e.g. PICES and CIESM countries.
Secretariat facilities:	Meeting room provided by the host
Financial:	None required
Linkages to advisory committees:	ACOM
Linkages to other committees or groups:	WGHABD, WGBOSV, WGBIODIV, WGAQUA, WGIMT, WGPDMO, WGBE, WGZE
Linkages to other organizations:	WGITMO urges ICES to encourage and support a continued dialogue with PICES, CIESM, IMO, HELCOM, OSPAR and EIFAC.

4 Progress in relation to Terms of Reference

The sections below provide information on the progress made on each of the Terms of Reference, and on amendments or conclusions/recommendations based on group discussions and contributions.

4.1 Term of Reference a)

Summarize information provided in national reports and through the AquaNIS information system. Develop annual summaries of new occurrences/introductions of aquatic non-indigenous species (NIS) (ToR lead Henn Ojaveer)

General

This Term of Reference was addressed by all meeting participants who provided information for their country according to the reporting template. This was done either via a short verbal report or in the form of more substantial presentation.

As agreed in 2014, WGITMO has shifted to reporting on new NIS via the AquaNIS information system http://aquanis.ku.lt. All group members have received detailed instructions on how to access the database and upload their information. Transition to online reporting, however, will take time since some countries are still in the process ofupdating their information. Presently, AquaNIS covers most areas in the North East Atlantic, while parts of the Mediterranean unfortunately remain with limited access.

The following sub-sections provide the summarized highlights of all national reports received. For details, please see Annex 3 (national reports).

4.1.1 Belgium

During 2015 a second small population of the Manilla clam *Ruditapes philippinarum* was discovered in Oostende. In October 2015 the read alga *Dasysiphonia japonica* has been found in situ on a pontoon in the Marina of Zeebrugge.

4.1.2 Canada

Fisheries and Oceans Canada has finalized the new Aquatic Invasive Species Regulations for the *Fisheries Act* and it is now in force in Canada effective June 17, 2015. (http://gazette.gc.ca/rp-pr/p2/2015/2015–06–17/html/sor-dors121-eng.php)

A National Recreational Boating AIS Vector Risk Assessment was conducted in 2015. (see presentation ToR d). *Didemnum vexillum*, confirmed for the first time in 2013 in Atlantic Canada in Minas Basin, in the upper Bay of Fundy, was reported at additional sites in 2015. Other species that have already invaded Canadian waters continue to spread, including European green crab (*Carcinus maenas*), vase tunicate (*Ciona intestinalis*), oyster thief (*Codium fragile*), golden star tunicate (*Botryllus schlosseri*), clubbed tunicate (*Styela clava*), European sea squirt (*Ascidiella aspersa*) and violet tunicate (*Botrylloides violaceus*).

4.1.3 Denmark

A report on pathway analysis and "horizon scanning" has been published by NOBANIS. Several meetings have been held related to the EU-list, implementation of MSFD D2, management of Pacific oyster (*Crassostrea gigas*) and round goby (*Neogobius melanastomus*). *Bonamia ostreae* was recorded for the first time (since monitoring began in 2000) in *Ostrea edulis* in the Limfjord.

4.1.4 Estonia

Shells of a new species for the country, the gulf wedge clam (*Rangia cuneata*) were found on the beach of the NE Gulf of Riga (Pärnu Bay). National non-indigenous species monitoring was continued in the scope and aims as in previous years. One of the aims is to monitor non-indigenous species in the high-risk areas of new invasions. Based on surveys in vicinity of the largest port in the country (Muuga harbor) no new non-indigenous species were identified in 2015. The cryptogenic cirriped (*Amphibalanus improvisus*) and the non-indigenous polychaete (*Marenzelleria neglecta*) appear to form very abundant populations. The round goby still colonises new areas and increases in abundance. However, its catches in gillnets in Muuga Bay (Gulf of Finland) have stabilized after five years of invasion (since 2010) and remained high. The Chinese mitten crab (*Eriocheir sinensis*) was not found in the long-term monitoring station in Muuga Bay. New evidences on the ecology and impacts of the predatory cladoceran (*Cercopagis pengoi*), Harris mud crab (*Rhithropanopeus harrisii*), the gammarid amphipod *Gammarus tigrinus* and the round goby were obtained. One specimen of the bighead carp (*Aristichthys nobilis*) was found in Pärnu Bay (NE Gulf of Riga).

4.1.5 Finland

A new Finnish law on non-indigenous species was drawn. A *Laonome* species (Sabellidae) found in 2014/15 is yet unidentified. The Conrad's false mussel (*Mytilopsis leucophaeata)* and the gibel carp (*Carassius gibelio*) have extended their distribution.

4.1.6 France

This year the French "loi pour la reconquête de la biodiversité" which ratifies the Nagoya protocol will enter into force. This strictly regulates the sampling of all genetic material and the subsequent data availabiity. A new non-native genus was reported this year: the amphipod *Aoroides* spp. Specimens from three different species (*Aoroides semicurvatus, A. curvipes* and *A. longimerus*) were collected along the French Atlantic coast. This is the first time *Aoroides* spp. has been found in European marine waters (Gouillieux *et al.*, 2015). The other new sightings are Say's Mud crab (*Dyspanopeus sayi*), the gastropods, *Nassarius corniculum* and *Gibbula ardens,* and the rhodophyte *Centroceras clavulatum* (Gully *et al.* 2013; Ruellet and Breton 2012; Le Duff and Ar Gall 2015). Recent studies of gelatinous zooplankton have shown the invasive comb-jelly (*Mnemiopsis leidyi*) to have an established population along the south-eastern coasts of the North Sea (David *et al.*, 2015), and the misidentification of *Nemopsis bachei, Blackfordia virginica* and *Maeotias marginata* (Nowaczyk *et al.* submitted) in the Gironde estuary. Genetic studies of the species complex *Ciona intestinalis* have revealed the co-occurrence in the English Channel of the invasive *Ciona robusta* (Bouchemousse *et al.* 2016) and the native *Ciona intestinalis.* The taxonomic revision of the former has recently been accepted for publication. Consequently, there are many issues regarding the history, dynamics and fate of the recent (last 15–20 years) introduction of *C. robusta* in the native range of *C. intestinalis*).

4.1.7 Germany

Several non-indigenous species were newly recorded in German waters and the findings were added to AquaNIS (data entry January 2016):

- 2014 *Echinogammarus trichiatus* was found in the Stettin lagoon (Germany, Mecklenburg-Western Pomerania) (Zettler 2015). This publication lists also other non-indigenous species from that Lagoon. We consider this lagoon as coastal waters adjacent to the Baltic Sea and many of these species listed were not yet known from the German Baltic coastal waters;
- 2014 the brush-clawed shore crab (*Hemigrapsus takanoi*) was recorded in the Baltic Sea for the first time (inner Kiel Fjord, Schleswig-Holstein) (Geburzi *et al.* 2015);
- 2014 *Synidotea laticauda* was found in the Port of Brunsbüttel (Schleswig-Holstein, North Sea) (Gesche Bock, Geomar, pers. comm.). This may not be the first record of this species in Germany as it was probably found earlier along the Lower Saxony coast;
- 2014 *Ficopomatus enigmaticus* was found in the Port of Schlutup (Schleswig-Holstein, Baltic Sea between Lübeck and Travemünde) (Gesche Bock, Geomar, pers. comm.);
- 2014 a single specimen of *Evadne anonyx* was found in the Kiel Bight. This is the first finding from German Baltic waters (Jörg Dutz, Leibniz Institute for Baltic Sea Research Warnemünde, pers. comm., Wasmund *et al.* 2015);
- 2015 *Dreissena rostriformis bugensis* was found in the Stettin Lagoon, which is possibly the first sighting of this species in German Baltic coastal waters (Michael Zettler, Leibniz Institute for Baltic Sea Research Warnemünde, pers. comm.) and;
- 2015 *Heterosiphonia japonica* was found at the German North Sea coast (Dagmar Lackschewitz, AWI, pers. comm.).

The non-indigenous diatom *Mediopyxis helysia* was first already recorded in spring 2009 in the backbarrier tidal flats of Spiekeroog Island (North Sea). This finding only became known by a recent publication (Meier *et al.* 2015).

Intentional species introductions remain at a similar level as last year. A species not yet known from Germany is *Didemnum vexillum*, but it is found in other European countries. It may be possible that this species becomes introduced to German waters with movements of living mussels and aquaculture gear or in the biofouling of vessels.

4.1.8 Israel

The southern Levantine coast, located down-current of the Suez Canal's opening into the Mediterranean, is under intense propagule pressure and consequently, hosts the highest number of established Erythraean alien species (Galil *et al.* 2016). Of the 31 species recorded between the ICES Working Group on Introduction and Transfers of Marine Organisms (WGITMO) in March 2012 and the present meeting, all but three are considered to have been introduced through the Suez Canal. The majority of the new records belong to the major introduced taxa in the Levant: 9, 8, 9 are mollusks, crustaceans and fish, respectively. All but eight are the earliest records for the Mediterranean Sea, highlighting the role of the southern Levant as a "hotspot", a beachhead and dispersal hub for their secondary spread.

The implication of a time lag between the first record and subsequent spread is that even were new introductions curtailed, populations of some Erythraean aliens already in the Levant are likely to increase and spread in future. The longer management of the Erythraean invasion is delayed, the larger the "invasion debt" we accrue.

4.1.9 Italy

One new species of algae, one jellyfish, two bryozoans, one amphipod, two shrimps and two fish species have been recorded for the first time along the Italian coasts. The amphipod record represents also the first finding in the Mediterranean Sea and the bryozoan *Watersipora arcuata* is the first record for the European seas. A few already established species continued to extend their distribution.

4.1.10 Lithuania

In total, 31 NIS and two crypogenic species are registered in the Lithuanian waters of the Baltic Sea and the Curonian Lagoon, of them 22 are established and maintain self-sustaining populations, 10 are not established and for one the population status is unknown. All new introductions (since 2004) were secondary, i.e. species entered the Baltic Sea via other countries and then spread to the Lithuanian waters either by natural dispersal or by human-mediated pathways. Specific molecular tools were developed (together with Spanish scientists) for early detection of invasive bivalve mollusc species *Dreissena polymorpha* and *Rangia cuneata* currently spreading in Europe.

4.1.11 Norway

No further genetic clarification of the origin of the snowcrab *Chionoecetes opilio.* It has previously been established that there is a significant genetic distance between the Barents Sea and the Canada/Greenland stocks. The snow crab continues to expand its range and population density in the Barents Sea. Specimen were caught in the W. part of the Kara Sea, but not in the eastern part (hence likely from the Barents Sea Stock). Slight increase in king crab *Paralithodes camtschaticus* stock from 2015, both catchable males and total numbers. The culling fishery (no quotas) W. of E 26° still seems to slow down (but not prevent) further SW migration and population growth.

Two records of American lobster (*Homarus americanus*) in Norway in 2015. Both from the area W and SW of Bergen. One berried female (*H. americanus* ♀ x *H. homarus* ♂). The eggs will be hatched at a quarantine-facility to monitor hatching success and survival.

A survey on the western coast of Norway by bryozoan taxonomic experts revealed presence of two alien species: *Tricellaria inopinata* and *Schizoporella japonica* (On the Western coast between Bergen and Trondheim).

While the Norwegian Biodiversity Information Centre still is the official Norwegian repository for information on Red-listed and Black-listed species (including NIS), a NIS expert group (to give advice on management) is established at "The Norwegian Scientific Committee for Food Safety" (see www.english.vkm.no).

4.1.12 Poland

The quagga mussel (*Dreissena rostriformis bugensis* Andrusov, 1897) was recorded for the first time in the Szczecin Lagoon in 2014 (Woźniczka *et al.*, 2016). *Chara connivens* P. Salzmann ex A. Braun 1835 was rediscovered in the Vistula Lagoon in 2011, almost 35 years after its last record. In 2012 the species was recorded for the first time in the Szczecin Lagoon (Brzeska *et al.*, 2015). It is an extremely rare and protected species in Polish brackish waters. *Rangia cuneata* (Mactridae) established in the Polish part of the Vistula Lagoon (Warzocha *et al.*, 2015). The species, first recorded in the Lagoon in 2010, has rapidly colonized almost the entire basin. *Dikerogammarus villosus* (Sowinsky, 1894) was recorded for the first time in the Polish part of the Baltic Sea basin: the Śmiała Vistula and the Vistula Lagoon (Dobrzycka-Krahel *et al.*, 2015). *Pacifastacus leniusculus* (Dana, 1852) were found in the Wieprza (southern Baltic coastal river) and its two tributaries (Dobrzycka-Krahel *et al.*, 2015).

4.1.13 Portugal

A list of 143 aquatic non-indigenous species (NIS) is registered for the Portuguese estuarine and coastal aquatic systems, and there were four new additions to the 2015 report. The inventory of NIS was restructured to include salt marsh species and cryptogenic species are not included. Portugal has a law on introduction of non-indigenous species, published in 1999, which is currently under revision and a list of invasive marine species is included in the submitted document. Surveys conducted recently in the aim of ongoing projects that address NIS confirmed the occurrence of several species previously recorded, including the Manila clam (*Ruditapes philippinarum*) and the soft-shell clam (*Mya arenaria*), different bryozoans (*Watersipora subtorquata*, *Ticellaria inopinata* and *Bugula neritina*) and tunicates (*Styela plicata*, *Styela clava*, *Microcosmus squamiger* and *Botrylloides violaceus*), the blue crab (*Callinectes sapidus*), the estuarine mud crab (*Rhithropanopeus harrisii*) and the mummichog (*Fundulus heteroclitus*). *Spartina patens* has been identified in several different estuarine systems as an abundant species in salt marsh areas.

4.1.14 Russia

Like in a previous years, the special kind of national NIS monitoring program is not established for Russian marine area. Information on appearance and distribution of aliens is collecting as a part of diverse national and regional monitoring surveys. Several species, new for national areas of Baltic Sea and Sea of Azov, were recorded during 2014–2015. Four new polychaete species could be regarded as NIS: Sabellid polychaetes *Laonoma calida* (?) was recorded first time for the Vistula Lagoon (Baltic Sea) in 2015. Later, the analysis of samples of 2013/2014 proved its presence in the area since June 2014. Other sabellid *Aracia heterobranchiata* (?) was recorded in the deltaic region of the Don River (Sea of Azov), also in 2014. Two more alien polychaete species of the genus *Marenzelleria* were collected in the Don River estuary and the Taganrog bay (Sea of Azov) in 2014. Most probable vector for all four introductions – ballast water; all mentioned species have demonstrated the signs of reproduction in the new areas. Taxonomic position of all 4 species is under consideration now.

Gammarid *Dikerogammarus vilosus* and *Dikerogammarus haemobaphes* two gammarid species, recorded in the marine littoral of Russian zone of South-Eastern Baltic (SEB) in 2015 for the first time.

Gammarid *Chaetogammarus warpachowsky* and mysid *Limnomysis benedini,* introduced intentionally long ago, in 1960s, were firstly recorded in the new geographic location of Russian SEB, starting range expansion since 2014/2015.

Well established former NIS *Neogobius melanostomus*, *Rangia cuneata*, *Marenzelleria neglecta, Eriocheir sinensis, Rhithropanopeus harrisii, Cercopagis pengoi, Gammarus tigrinus*, *Pontogammarus robustoides, Obesogammarus crassus* are constantly recording in Russian SEB and have a leading position in the communities.

Re-identification of materials 2001–2015 from off-shore marine areas of Russian SEB let to conclude: polychaete *Marenzelleria arctia* is dwelling in marine habitats, in the Vistula Lagoon another species, *Marenzelleria neglecta,* occurs.

Bivalve Rangia cuneata, reported in 2013 from off-shore area of Russian SEB, can't establish and disappeared in 2014/2015. Field observation show the increase of frequency and range of distribution of several Ponto-Caspian aliens in 2014/2015. No new published records of alien species in the Gulf of Finland and the Black Sea areas

4.1.15 Sweden

No new nonindigenous species have been discovered in 2015, but it was revealed that the polychaeta *Boccardiella ligerica* was first discovered in Sweden in 2013. There have been some new reports of American lobster *Homarus americanus* in Kattegat/Skagerrak, including egg-bearing females and the round goby *Neogobius melanostomus* continues to spread and increase in density in the Baltic Sea.

4.1.16 United Kingdom

Various monitoring exercises and biosecurity projects have been completed during 2014 by institutions throughout the UK. These include a published biosecurity Plan developed for the Shetland Isles that provides supplementary guidance to the Shetland Islands' Marine Spatial Plan. Scottish Natural Heritage published guidance for preparing a non-native species biosecurity plan for sites/operations. The Environmental Research Institute published results from a rapid assessment of marinas and harbours for marine non-native species as well as a study on biofouling of commercial vessels. The Marine Biological Association has conducted a number of studies assessing the distribution of non-native species in English and Welsh marinas using rapid assessments. Data gathered have been compared to previous similar studies to assess spread.

Cefas has developed and trialled molecular tools and techniques by which to detect the presence of NNS from the DNA found in environmental samples (e.g. scrape, sediment, water). Cefas has also been using environmental DNA (eDNA) analysis to detect specific non-native species such as the warty comb jellyfish (a.k.a sea walnut) *Mnemiopsis leidyi* and, in collaboration with Bournemouth University, four freshwater fish species: top-mouth gudgeon (*Pseudorasbora parva*), sunbleak (*Leucaspius delineatus*), pumpkinseed (*Lepomis gibbosus*), and fathead minnow (*Pimephales promelas*). This work includes the use of eDNA to assess the efficacy of invasive species eradications. Cefas is also developing a method using molecular information on populations of NNS present in the UK, along with information regarding the potential pathways by which these species could have been introduced and spread, to determine from where the populations originated and the nature of their introduction. Cefas and the University of Leeds have conducted a number of studies examining the use of hot water as a biosecurity tools in the freshwater environment, with a range of invasive plant and inverterbrate species tested. Results of these studies indicate that a water of temperature of 40°C may be effective for the invasive plants and invertetrates. Additionally, a fact-finding exercise was undertaken in New Zealand to assess how the awareness and up-take of the biosecurity programme 'Check, Clean, Dry' has been maintained for over a decade. Cefas has undertaken preliminary assessments of chemical control agents delivered through a spiked-bait feeding station system in the control of signal crayfish (*Pacifastacus leniusculus*) and killer shrimp (*Dikerogammarus villosus*).

Cefas has continued to co-ordinate the Marine Pathways Project. The project has had contributions from a number of organisations from across the UK and Republic of Ireland. Work conducted by the project has included the assessment of high risk location of introduction, the development of biosecurity advise for stakeholders, the development of monitoring and surveillance programmes and tools, including assessing the distribution of certain marine non-native species, in addition to examining control measures for certain marine invasive species. The Marine Pathways Project officially ended in March 2015. Nonetheless, the Marine Pathways group continues, with support from Defra (co-ordinated by Cefas), to act as an expert steering group, sharing knowledge and experience and providing advice on the subject of marine NIS to inform Policy and management.

Cefas has continued to investigate methods of controlling invasive species of crayfish, with a 2.5 year trapping study, which is due to end in March 2015, Cefas has developed a new aquatic invasive species screening tool (Aquatic Species Invasiness Screening Kit (AS-ISK). This is now available (https://www.cefas.co.uk/services/research-advice-and-consultancy/invasive-and-non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/) and is currently being validated and trailled in assessments of a range of freshwater, brackish and marine species, including multiple assessments of the Manila clam (*Venerupis philippinarum*) by several risk assessors for different risk assessment areas world-wide.

Cefas is currently developing a NNS monitoring and surveillance programme to cover the UK. Expected to be implemented from April 2016, this is based on the incorporation of NNS reporting into existing statutory marine monitoring programmes.

Other projects that have been completed in 2015 include a Scottish Pacific oyster survey, an invasive non-native species early warning system project, a genetic study of UK populations of carpet sea squirt (*Didenmum vexillum*) and the 2015 marina surveys in Orkney.

A new record for asp (*Aspius aspius*) came from Churchgate Fishery, near Battlesbridge, Essex (England). Many American lobster (*Homarus americanus*) and Dungeness crabs (*Metacarcinus magister*) were released off the south coast of England as part of a Buddhist religious ceremony in June. Roughly half of these have since been caught and efforts to capture the rest are on-going. New locations also include two American lobsters from the Solway Firth, compass seasquirt and Japanese wireweed in Orkney, Pacific oyster (*Crassostrea gigas*) in Shetland, carpet sea squirt in Loch Creran, and a population of pumpkinseed in Basildon.

4.1.17 United States

There is only one new non-native species reported this year, a polychaete, *Branchiomma coheni* that has been found in Tampa Bay Florida for several years.

The clinging jellyfish (*Gonionemus vertens*) has been present since 1894, but is now causing severe stings associated with the Pacific species and may be a new introduction.

Genetic studies of two amphipod species (*Orchestia gammarellus* and *Corophium volutator*) have been shown to be non-native in the Northwest Atlantic. Several recently-introduced species are expanding their ranges: *Colpomenia peregrina* (moving south), *Palaemon macrodactylus*, *P. elegans*, and *Dasysiphonia japonica*, with the barnacle *Chthamalus fragilis* appearing to be move northward, probably with increasing water temperatures.

STATUS UPDATE on the Information system on aquatic non-indigenous (NIS) and cryptogenic (CS) species, AquaNIS (by Sergej Olenin)

According to the WGITMO decision (WGITMO, 2014; 2015), AquaNIS is recommended to assemble, store and disseminate comprehensive data on NIS recorded in ICES Member States. The records cover new findings of NIS during the current reporting period (e.g. 2015) as well as changes made to existing data (e.g. corrections, changes in taxonomy, species population status, etc.). The system also contains data on species findings in ports and their vicinities. The Editorial Board of AquaNIS seeks to ensure the long-term maintenance and reliability of the database by continuous update and scientific validation of its data, making it useful for research and practical for management. Data stored in AquaNIS may be used to measure progress towards implementation of environmental targets set by such legislative acts as EU Marine Strategy Framework Directive, EU Regulation 1143/2014 on Invasive Alien Species, IMO Ballast Water Management Convention, etc.

New developments since March 2015

Currently AquaNIS contains data on 1430 species recorded in 4390 introduction events (documenting a species introduction into a recipient region) in 19 Large Marine Ecosystems (LMEs); (Table 4.1.1).

Table 4.1.1. Number of species and introduction events recorded in AquaNIS (by March 15, 2016).

Large Marine Ecosystem or LME-like system*	# of species	# of introduction events	Data availability
18. Canadian Eastern Arctic - West Greenland	2	2	Free, online
20. Barents Sea	12	14	Free, online
21. Norwegian Sea	19	19	Free, online
22. North Sea	267	612	Free, online
23. Baltic Sea	132	443	Free, online
24. Celtic-Biscay Shelf	244	555	Free, online
25. Iberian Coastal	133	177	Free, online
26. Mediterranean Sea	686	1841	Restricted access (except data for Italy)
36. South China Sea	2	2	Free, online
46. New Zealand Shelf	6	12	Free, online

47. East China Sea	1	1	Free, online
48. Yellow Sea	13	13	Free, online
50. Sea of Japan / East Sea	2	4	Free, online
59. Iceland Shelf	11	11	Free, online
60. Faroe Plateau	5	5	Free, online
62. Black Sea	294	518	Free, online
63. Hudson Bay Complex	6	6	Free, online
A1. Macaronesia	106	131	Free, online
A2. Caspian Sea	24	24	Free, online

*** LME-like ecosystems, e.g. Caspian Sea (for details see Olenin *et al.*, 2014).**

The database content was essentially updated since the previous reporting period. In total corrections/additions were made in 1151 new and existing introduction event records. New information was added on 183 species involved in 582 introduction events, including 22 NIS that previously were not recorded. The taxonomy of these new species (as well as of all other species recorded in AquaNIS) is based on the updated accounts in a global organism-specific database, World Register of Marine Species (WoRMS). It is linked to the list of NIS in a form of a drop-down menu, thereby preventing typing errors while entering data.

Not all of these introductions have happened during the reporting period (since 2015) – such a big number of new NIS and introduction events is explained by dedicated research effort of several contributors, who essentially updated the database content, especially in the Black Sea (340 introduction events added), Baltic Sea (69), North Sea (44), the Italian part of the Mediterranean Sea (44) and the Iberian Coastal LME (33). During the present year, plans are in place for data on NIS to be recorded within the Mediterranean costs of France and Spain will be updated and opened for free access.

It is also important to note that all changes to the introduction events as well as to species biological traits records are stored in the database and can be made available for the additional examination if needed.

AquaNIS as research infrastructure

AquaNIS increasingly is being used as a source of verified valuable information, which is utilized in several recent publications, e.g. (Cardeccia *et al.* 2016; Olenin *et al.* 2016; Ojaveer *et al.*, submitted). The value of the database will grow in the future, if ICES WGITMO will ensure constant input of reliable and verified information. Curently AquaNIS is running on the server of Klaipėda University (Lithuania), while the backup copy of the entire database content is stored at the ICES data centre.

Literature

Cardeccia A., Marchini A., Occhipinti-Ambrogi A., Galil B., Gollasch S., Minchin D., Narščius A., Olenin S., Ojaveer H. 2016. Assessing biological invasions in European Seas: Biological traits of the most widespread non-indigenous species. Estuarine, Coastal and Shelf Science (first online) www.sciencedirect.com/science/article/pii/S0272771416300579

Ojaveer H., Olenin S., Narščius A., Florin A-B., Ezhova E., Gollasch S., Jensen K.R., Lehtiniemi M., Minchin D, Normant-Saremba, M and Strāke S. Dynamics of biological invasions and pathways over time: a case study of a temperate coastal sea. Biological Invasions (submitted).

Olenin, S., Ojaveer, H., Minchin, D., Boelens, R. 2016. Assessing exemptions under the ballast water management convention: preclude the Trojan horse. Marine Pollution Bulletin, 103, 84–92

Olenin S., Narščius A., Minchin D., David M., Galil B., Gollasch S., Marchini A., Occhipinti-Ambrogi A., Ojaveer H., Zaiko A. 2014. Making non-indigenous species information systems practical for management and useful for research: an aquatic perspective. Biological Conservation, 173, 98–107

MOLECULAR TOOLS

As was decided at the WGITMO 2015 meeting, the development and application of molecular tools should remain on the WGITMO agenda in coming years. Two related issues were presented and discussed, as given below.

REVIEW ON TAXONOMIC TOOLS FOR NIS (BY THOMAS LANDRY)

Thomas Landry led a discussion on the use of molecular tools with a presentation on "Review of taxonomic tools for NIS". His presentation was preceded by the country report session (ToR a), where several countries indicated some progress in the development of molecular tools for the detection and identification of new NIS. Earlier, during the WGBOSV meeting, John Darling provided a review on the recent advancement in molecular techniques for genetic investigations. The presentation by T. Landry focused on some of the challenges that had been discussed during the previous WGITMO meeting (ToR f) in Bergen, Norway with a focus on the terminology. The presentation covered two main challenges; 1) Operational Taxonomic Unit (OTU), and 2) Management Classification (MC). For the OTU, definitions for "species", "sub-species", "strain (type)", "hybrids" were reviewed with the standpoint that the high genetic variability sometimes associated with new NIS contributes to complex identification and subsequent management strategies (Roman & Darling 2007). A discussion on the ascidian sea squirt *Ciona intestinalis* with four possible "types", was a clear illustration of this challenge. This is becoming a growing challenge for WGITMO and WGBOSV as well as other Expert Group (EG) within ICES (i.e. WGAQUA, WGAGFM, WGPDMO, WGBS, and WGIMT).

The discussion on the Management Classification (MC) reviewed the use of the confusing terminologies applied with NIS, including "Nuisance", "Invasive", "Exotic" and "Alien". Again, these are growing challenges with the development of legislative approach and management strategies among member countries as well as with external organisations. This was well reflected in the discussions with participants of WGITMO, who did not want to revisit this challenge at this time due to time constraint. The proposed approach of developing a publication plan (based on the example from WGEIM in defining various types of "Carrying Capacity" in Aquaculture), was therefore not fully discussed and may be an action to be initiated intersessional. Some members of the WGITMO responded positively to this initiative.

The WGITMO-WGIMT cooperation so far has already resulted in a joint publication: Bucklin A., Lindeque P.K., Rodriguez-Ezpeleta N., Albaina A. and Lehtiniemi M. 2016: Metabarcoding of marine zooplankton: prospects, progress and pitfalls. Journal of Plankton Research; doi: 10.1093/plankt/fbw023

Conclusion and recommendation

The WGITMO agreed with the suggested approach of organizing a special workshop with others EGs to review and provide agreed guidelines for adopting OTU to deal with this challenge in light of the rapid development of molecular tools. T. Landry will lead this effort with the support of Bella Galil, Thomas Therriault and Stephan Gollasch. T. Landry will also seek the support from the chairs of the other EG's.

Development and application of molecular methods for the early detection of marine Aquatic Invasive Species (AIS) in ballast water (by Anaïs Rey)

The transportation of aquatic species by ships' ballast water is one of the most important vectors by which Aquatic Invasive Species (AIS) are introduced to new aquatic ecosystems around the world. The aim of this PhD (2015–2018) is to develop and optimize DNA-based methods to early detect marine invasive species transferred by ballast water. By exploring how molecular tools could be implemented, we want to contribute to fill the gap between research and management in the early detection of AIS in ballast water. The first objective is to calibrate molecular methods with artificial communities of known composition to optimize (1) identification of early stages of macro-organisms, rare species, bacteria and viruses; (2) estimation of relative abundance of the species and (3) estimation of the living status of organisms. DNA or RNA metabarcoding and qPCR are the molecular tools considered in this study. The second objective is to get a first national overview of the ballast water activities and so, assess the risk level of potential AIS introduction and exportation by gathering data on the origin and the amount of loaded and discharged ballast water into major ports of Spain. Related to the Ballast Water Management Convention, representativeness of ballast water sampling and port risk assessment will be also conducted during this project. Ballast water and port sampling will be performed once appropriate molecular tools have been chosen and calibrated through the artificial communities approach.

This PhD is part of the project Aquainvad-ed (http://www.aquainvad-ed.com/) and has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 642197.

4.2 Term of Reference b)

Continue addressing EU MSFD D2 on further developing and evaluating NIS indicators and screening and identification of species of concern (ToR lead Sergej Olenin)

This ToR was dealt with as planned at the WGITMO meeting in 2015, by involving two different activities. These were addressed intersessionally and presented at the meeting. The first presentation was about generic, but essentially relevant issues related to both research and management of NIS.

COUNTING AND ACCOUNTING: INVENTORIES OF MARINE ALIEN SPECIES *(by Agnese Marchini)*

Regional inventories of alien species have scientific, political, commercial and social relevance: they provide the baseline for the development of policies for prevention and control, they influence funding priorities and help raising public awareness. Therefore, it is crucial that the inventories that are distributed ensure accuracy, reliability and timely update. Unfortunately, no agreed guidelines for the compilation of inventories of alien species exist yet, and in the last years there has been a proliferation of databases based upon different criteria of record inclusion.

In this work we cross-compared inventories of Mediterranean alien species obtained from published and on-line sources, and found that the level of mismatch can represent up to 30–35% of the total records of alien species.

The doubtful records were submitted to in-depth investigation of their taxonomic status, geographical distribution, habitat preference and circumstances of their introduction and collection. The results of this study reveal records affected by different types of uncertainty, which we classify into three categories: (i) identity; (ii) 'alien' status; (iii) occurrence.

This work aims to encourage discourse on logical and transparent criteria to substantiate records of alien species, in order to improve the quality of the information provided to the scientific community, to policymakers and to the society. Otherwise, the propagation of conflicting and erroneous data may end in undermining management of invasive species.

The contents of this talk are also available in the journal article: Marchini A., Galil B.S. & Occhipinti-Ambrogi A. (2015) Recommendations on standardizing lists of marine alien species: lessons from the Mediterranean Sea. Marine Pollution Bulletin, 101, 267–273.

INDICATOR ON THE NUMBER OF NEW NIS (by Sergej Olenin)

Background and objectives

The European Environmental Agency proposed an indicator "Cumulative numbers of alien species in Europe since 1900" (EEA, 2007) to measure progress toward achieving a goal ("significant reduction in the current rate of biodiversity loss") set by the Convention on Biological Diversity. A similar indicator (2.1.1. Trends in abundance, temporal occurrence and spatial distribution in the wild of non-indigenous species…), based on EC Decision (2010/477/EU) was used by most Contracting Parties in their initial environmental status assessments for MSFD (Chainho *et al.*, in prep.).

Indeed, an elevated number of non-indigenous species (NIS) generally indicates a greater exposedness of a marine area to the effects of anthropogenic activity (Olenin *et al.*, 2010 and references therein). However, in contrast most indicators of human impacts, the cumulative number of NIS does not show a direct correlation with environmental degradation gradient. Whether or not NIS become established is only in part related to environmental status of the area; it also depends on biological traits of the species and integrity of native ecosystems.

On the other hand, the precise dates and circumstances of an arrival of a species are often difficult to determine, because for many early introductions taxonomic knowledge was incomplete and records seldom kept. Even in recent decades the presence of an NIS is often unnoticed until such time as they have either become obvious and/or have created some nuisance impact (Olenin & Minchin, 2011).

Thus, the "cumulative number of NIS" has little indicator value, therefore a new parameter – "**Trends in the arrival of new NIS" (*N-NIS*)** is proposed.

This new indicator is aimed to establish:

a) "windows" (or hotspots) of primary introductions into European regional seas;
b) pathways and vectors of primary introductions;
c) main donor areas of primary introductions.

Material and method

Recipient region and initial assessment.

N-NIS should be counted as the number of new NIS in a recipient region, which were recorded since the initial assessment (or another established date). Here, the recipient region is a country or a country sub-area within a Large Marine Ecosystem (LME) or LME sub-region for example: "Germany-LME23_Baltic Sea", "Germany-LME22_North Sea", ''Italy-LME26_Mediterranean Sea/sub-region Adriatic Sea''. In order to involve all important geographical areas of shipping activities and major donor/recipient areas of NIS it was proposed to also include larger regional waterbodies, not covered by the LME framework, such as the Caspian Sea or the Laurentian Great Lakes of North America, (Olenin *et al.*, 2014).

Most EU Member States performed initial environmental status assessments under the Marine Strategy Framework Directive (MSFD) and reported the cumulative number of NIS in the waters under their jurisdiction recorded by 2010. Consequently, all new NIS, which arrived after this date, should be counted. It is important that ***N-NIS*** is counted for recipient regions or LMEs, where NIS monitoring or, at least, well-established long-term biological monitoring is in place.

Level of primary introduction and the secondary spread.

Primary introduction is the first arrival of a NIS from a distant source to a particular recipient region, i.e. to a country or a country sub-area within a LME or LME sub-region, e.g.: "Germany-LME23_Baltic Sea", "Germany-LME22_North Sea", ''Italy-LME26_Mediterranean Sea/sub-region Adriatic Sea.

The level of primary introduction indicates whether the NIS is new for a particular LME (Level 1, e.g. LME23. Baltic Sea), for a larger biogeographical region (Level 2, e.g. neighbouring LME23 + LME22 North Sea), or entirely for all European regional seas (Level 3).

The secondary introduction is the spread of a species within a biogeographical region after having been introduced from elsewhere following a primary introduction. Such NIS may subsequently become distributed by the same pathway/vector (e.g. shipping/ballast water) or by several other human-mediated vectors (e.g. aquaculture), or by natural processes (such as tidal movements, alongshore drift, waterfowl, etc.). The secondary introductions seriously compromise the ability to manage spread of alien biota.

In some cases, multiple introductions from the same distant source are possible, making it difficult to distinguish between primary and secondary introductions within LME or larger biogeographical region. The development of eDNA techniquecs will help to solve such problems in the future.

Technical precondition: availability of a NIS database

Technical precondition for calculation of N-NIS indicator is the availability of a pan-European, continuously updated and verified source of information, such as the Information system on Aquatic Non-Indigenous and Cryptogenic Species (AquaNIS, 2016). The hierarchical principle of geographic information arrangement applied in AquaNIS (for details see Olenin *et al.*, 2014) allows retrieving data for individual countries, separate LMEs or larger biogeographical regions (a group of LMEs). Since all introduction event records include the date of NIS arrival into particular recipient regions, it is possible to establish primary and secondary introductions with sufficient accuracy.

Calculation of N-NIS using AquaNIS

The calculation procedure includes several steps (illustrated here for the LME23 Baltic Sea using AquaNIS data as per 2016–03–18); (Table 4.2.1, Figure 4.2.1).

Table 4.2.1. The procedure to calculate N-NIS indicator value using the information system on aquatic non-indigenous and cryptogenic species AquaNIS (2016).

Action	Result	Explanation and interpretation
1) Using the "Search" function select species registered in the LME 23. Baltic Sea since 2010 (Search 1).	29 species involved in 38 introduction events	The date is set to 2010, because the initial assessments for MSFD were based on NIS registered before this year. There are ten recipient regions in the Baltic Sea: 8 bordering countries plus two geographically separated regions of the Russian Federation (St. Petersburg and Kaliningrad areas). From 2010, 38 introduction events were recorded in these recipient regions, involving 29 species. Some of these species, however, spread from other recipient regions (as secondary introductions), i.e. they are new for a recipient region, but not new at the level of the LME.
2) Using the "Search" function select species registered in the LME 23. Baltic Sea before 2009 (Search 2).	117 species involved in 394 introduction events	These numbers are needed for comparison of search results.
3) Using the "Comparison of search results" function compare Search 1 and Search 2	12 species involved in 17 introduction events	12 new species appeared in the Baltic Sea since 2010, hence *N-NIS = 12* Some of these 12 species have spread to neighboring countries during that period (2010–2015), that's why the number of introduction events (17) is higher than the number of new species.
4) Using the "Further analysis" function, determine in which countries new NIS appeared in.	Denmark – 1, Estonia – 1, Germany – 7, Poland – 2, Russia/Kaliningrad – 1, Sweden - 1	These numbers show the "windows" of primary introductions into the Baltic Sea (with Germany as a leading recipient region). One species was found simultaneously in a water body shared between Germany and Poland, therefore the primary introduction is ascribed to two countries.

5) Using the "Further analysis" function to find out what pathways/vectors were involved and what is the level of certainty.	Pathways: Vessels – 11 (1– direct evidence, 3 highly likely, 7 possible), Culture activities – 2 (2 possible). Natural spread from neighboring regions – 4 (1 highly likely, 3 possible).	These numbers indicate that "Vessels" (with vectors "Ballast water", Ship hull" and "Tank sediments") is the most important pathway of primary introductions. The level of certainty is high (Direct evidence or Highly likely) in 36 % of the species.
6) Using the "Search" function select species registered in LME 22 (North Sea) before 2010 (Search 3).	205 species involved in 570 introduction events	These numbers are needed for comparison of search results.
7) Using the "Comparison of search results" function compare Search 1 and Search 3	9 species	9 species are primary introductions at level 2 (a larger biogeographical region, in this case: LME22 North Sea + LME23 Baltic Sea). 3 species (possibly) are secondary introductions from the North Sea into the Baltic.

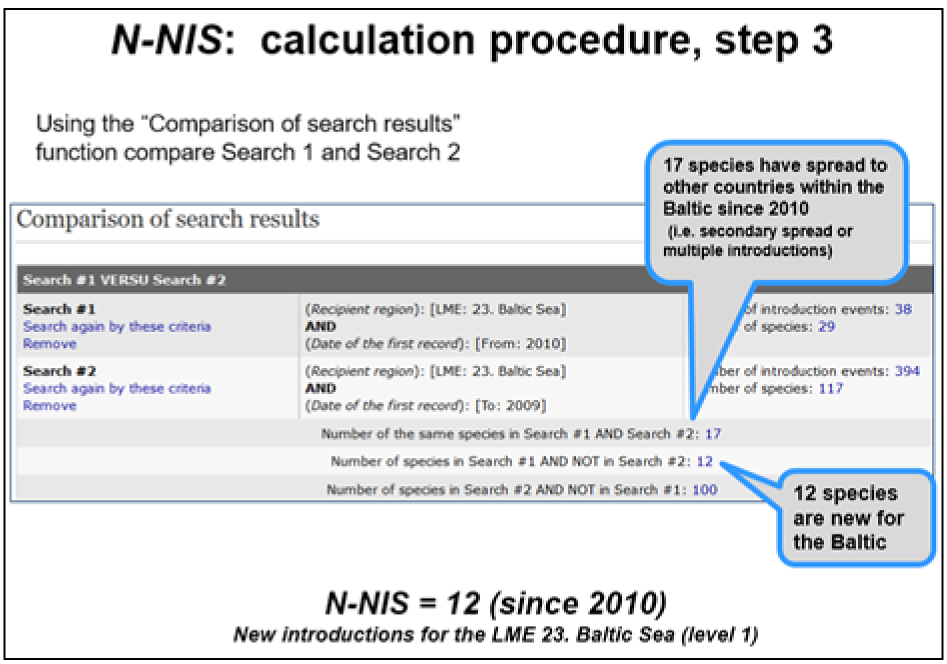


Figure 4.2.1. Calculation of N-NIS using AquaNIS: print screen of the system's function "comparison of search results". This function allows to determine the number of new NIS that appeared since 2010.

Policy relevance

The proposed indicator "*N-NIS*" provides a clear measure of effectiveness of legal and administrative instruments aimed at the prevention of alien invasive species introductions, such as EU Regulation 1143/2014 on Invasive Alien Species, MSFD, ICES Code of Practice on the Introductions and Transfers of Marine Organisms, the International Convention for the Control and Management of Ship's Ballast Water and Sediments and the

IMO biofouling guideline and guidance documents. The proposed indicator is important for assessment of introduction rates, especially in relation to management of invasion pathways and vectors; it may advise monitoring actions and support management decisions. For example, in some cases, where the natural dispersal capability of an NIS exceeds any management attempt to control its secondary spread, then a mitigation approach may be the only appropriate response (Ojaveer *et al.*, 2014).

References

AquaNIS. Editorial Board, 2016. Information system on Aquatic Non-Indigenous and Cryptogenic Species. World Wide Web electronic publication. www.corpi.ku.lt/databases/aquanis. Version 2.36+. (Accessed 2016–03–18).

Ojaveer H., Galil B.S., Minchin D., Olenin S., Amorim A., Canning-Clode J., Chainho P., Copp G.H., Gollasch S., Jelmert A., Lehtiniemi M., McKenzie C., Mikus J., Miossec L., Occhipinti-Ambrogi A., Pećarević M., Pederson J., Quilez-Badia G., Wijsman J.W.M., Zenetos A. 2014. Ten recommendations for advancing the assessment and management of nonindigenous species in marine ecosystems. Marine Policy, 44, 160–165.

Olenin S. & Minchin D. 2011. Biological Introductions to the Systems: Macroorganisms. In: Wolanski E. & McLusky D.S. (eds.) Treatise on Estuarine and Coastal Science. Elsevier, Academic Press, Vol 8, pp. 149–183.

Olenin S., Alemany F., A. Cardoso C., Gollasch S., Goulletquer P., Lehtiniemi M., McCollin T., Minchin D., Miossec L., Occhipinti Ambrogi A., Ojaveer H., Jensen K.R., Stankiewicz M., Wallentinus I. & Aleksandrov B. 2010. Marine Strategy Framework Directive - Task Group 2 Report. Non-indigenous species. EUR 24342 EN. ISBN 978–92–79–15655–7. ISSN 1018–5593. DOI 10.2788/87092. Luxembourg: Office for Official Publications of the European Communities. 44 pp.

Olenin S., Narščius A., Minchin D., David M., Galil B., Gollasch S., Marchini A., Occhipinti-Ambrogi A., Ojaveer H. & Zaiko A. 2014. Making non-indigenous species information systems practical for management and useful for research: An aquatic perspective. Biological Conservation, 173, 98–107.

A cross-regional comparison of non-indigenous species indicators: problems and opportunities for a common assessment *(by Paula Chainho)*

Initial assessment reports and monitoring programs provided by Member States (MS) in the aim of the implementation of the Marine Strategy Framework Directive (MSFD) were examined to i) identify methodological problems related to the use of different criteria for the implementation of indicators for the descriptor D2 (non-indigenous species – NIS) and ii) to propose methodological recommendations. Assessments submitted by Ireland (IE), United Kingdom (UK), Belgium (BE), Germany (DE), France (FR), Spain (ES), Portugal (PT), Estonia (EE), Lithuania (LT), Finland (FI), Italy (IT) and Israel (IL) were surveyed as representative case studies of the different Regions and sub-regions of the MSFD (Table 4.2.2).

Table 4.2.2. Member States (MS) used as representative case studies of different regions and sub-regions of the MSFD for which initial assessment reports and monitoring programs were scrutinized. The number of non-indigenous species (NIS) reported by each MS is indicated

Region	Sub-Region	Countries (number of NIS)
Northeast Atlantic	Greater North Sea	UK (95), DE (49), FR (97), BE (23)
	Celtic Seas	IE (59), UK (58), FR (20)
	Bay of Biscay & Iberian coast	PT (38), ES (88; 225), FR (129)
Baltic Sea	-	DE (27), FI (34), LT (13), EE (32)
Mediterranean Sea	Western Med. Sea	ES (88), IT (117), FR (148)
	Ionian Sea & Central Med.	IT (96)
	Adriatic Sea	IT (94)
	Aegean-Levantine Sea	IL (362)

Different numbers of NIS were reported by neighbouring countries for most regions and sub-regions (Table 4.2.2). This might be related to the inclusion of estuaries and coastal lagoons in the assessment of NIS by most countries but only coastal areas (according to the Water Framework Directive definitions) by some MS (*e.g.* PT and DE) and also to the inclusion versus exclusion of cryptogenic species by different MS.

Comparisons for the MSFD D2 indicator 2.2.1, trends in abundance, temporal occurrence and spatial distribution, within and between regions and sub-regions were biased because:

i) different periods were considered by different MS;

ii) some MS used only the year of first record while others accounted for all known sightings;

iii) some MS assessed trends in abundance and spatial distribution for all NIS while others selected only specific NIS or even only invasive NIS;

Most countries did not calculate ratio invasive/native species as required by indicator 2.2.1 and there was a high heterogeneity in the taxonomic groups used within those that assessed this indicator. Moreover, since this ratio was mostly calculated at national level it provides an underestimated overview of the possible impacts of NIS since these impacts are observed mainly at local/regional level.

The assessments conducted for the indicator on impacts of non-indigenous invasive species at the level of species, habitats and ecosystem revealed a very deficient knowledge of these impacts across all regions. Most countries indicated types of impacts only for some species, with no quantification of these impacts and most MS propose specific assessment tools for future assessments, such as the Biopollution index (PT; ES; FI; LT; EE), the ratio invasive/native (ES; FI), the GBNNSS Risk Assessment Process (UK), the Hulbert's index; and the Shannon index and taxonomic distinctness (ES).

This first cross-regional comparison revealed a weak collaboration of MS within regions and sub-regions for the common assessment of the environmental status, which produced a highly heterogeneous understanding of criteria and indicators of the D2 descriptor. The following recommendations were based on a detailed inspection of the inconsistencies of MS assessments:

1) Include estuaries and coastal lagoons in the NIS assessments – shipping is a major pathways of introduction of NIS and harbours and recreational marinas are located mainly at estuaries, coastal lagoons and coastal areas. The spatial scope of the MSFD includes overlapping areas with the Water Framework Directive, so far as particular aspects of the environmental status of the marine environment are not already addressed through that Directive, as it is the case of NIS;

2) Early warning systems shared within regions and neighbouring countries

3) Common regional databases – a common regional databases on NIS should be used as a reference baseline for the MSFD assessments. This should be based on a common understanding of the use of the concepts of NIS (excluding cryptogenic species) and invasive species;

4) Define a spatial minimum for surveillance monitoring (all NIS, nationwide) and operational monitoring (potential invasive species, risk areas);

5) Use similar periods to determine temporal trends (assessment periods)

6) Calculate the invasive/native species ratio locally (at the sample level) at ecological homogenous areas (e.g. estuary, coastal lagoon, rocky shore stretch) or risk areas (e.g. recreational marina, harbour area, aquaculture neighbourhood, offshore renewables, navigation, canals), based on abundance data;

7) A strong effort on research focused on impacts of NIS is needed, with improvement of the collaboration between researchers and decision makers;

8) Clear prevention and mitigation measures for NIS introduction throughout the Suez Canal are need to be implemented since it represents a major threat for the achievement of D2 objectives.

A rapid assessment method (*by Dan Minchin*)

The need for monitoring has expanded in line with the many regulations and directives and yet the costs of sending workers into the field has increased. Managers require basic information on invasive species and without monitoring these cannot be managed. There is a fast survey method, based on the abundance and distribution range of a target species, that uses a selective approach for a single (or several) species of concern, Once encountered, a rapid management response may be enabled, thereby reducing the opportunities for further spread. To be effective the species must be easily recognized. Thirty or more stations are needed in an assessment. This method has been applied in rivers, lakes, lagoons and a port targeting infauna to sessile biota.

The method is based on the abundance and distribution range of the biopollution method (*Mar. Poll. Bull*. 55:379–394). The size of the area under study is the assessment area defined by the field-worker(s) for a specific time period using stated equipment. Abundance levels range on a three point scale from low to high. For example, it is '*low*' where a species occupies less than ~5% cover, '*moderate*' where the species cover is less than half of the substrate and '*high*' where more than half of the substrate is covered. The distribution scales for each assessment unit range from '*local*', if present at one station, '*several localities*' if present in fewer than half the stations, '*many localities*' if present on more than half of the stations, and '*all localities*' if present at all stations. Combinations of abundance and distribution provide five levels ranging from 'A', low numbers present at one station, to 'E', high abundance at all stations (Table 4.2.3).

Table 4.2.3. Classes of abundance and distribution (ADR) according to Olenin *et al.* (2007).

Abundance	Distribution scale			
	One locality	Several localities	Many localities	All localities
Low	A	A	B	C
Medium	B	B	C	D
High	B	C	D	E

Trial assessments using the Aquatic Species Screening Kit (AS-ISK) for several risk assessment areas and taxa (*by Gordon H. Copp*)

In following to the development of a taxonomically-generic screening module for any aquatic species (marine, brackish, fresh water), plant or animal (Copp *et al.* 2016), the risk screening questions and guidance protocols contained in this paper-based module were refined and combined with the architecture of an existing, widely-used electronic toolkit, the Fish Invasiveness Screening Kit, FISK (Copp 2013; Lawson *et al.* 2013). The resulting electronic decision-support tool, the Aquatic Species Screening Kit (AS-ISK) was released for free download in Sept. 2015 (www.cefas.co.uk/nns/tools/), and the manuscript in which this new electronic toolkit is described is currently under review by an international peer-reviewed journal (Copp *et al.*, unpublished). This descriptive manuscript includes an example screening assessment of the Manila clam (*Ruditapes philippinarum*). Owing to the relatively wide application of FISK (across five continents), AS-ISK is anticipated to be equally popular due to its generic aquatic scope for application in virtually any climate zone. Therefore, a series of risk screening of non-native marine, brackish and freshwater plants and animals was initiated during 2015, and these are to be completed during 2016. These screenings consist of two groups of assessment:

1) individual assessments by a single assessor of aquatic plant and animal taxa from various risk assessment areas and types of environment (marine, brackish, fresh water); and
2) multiple independent assessments of the same species, Manila clam, by multiple assessors for a variety of risk assessment areas.

The first group of assessments are intended to trial AS-ISK across a range of taxonomic groups, a range of environments and thus a range of risk assessment areas in which the species have been, or are likely to be, introduced (or could invade via natural dispersal). The current list of taxa and their environments and risk assessment areas are given here below:

		Species name		
Environment	**Taxon group**	**Common**	**Scientific**	**RA area**
Freshwater	Fish	Nile tilapia	*Oreochromis niloticus*	Pearl River Basin, China
Freshwater	Fish	Armour catfish	*Pterygoplichthys* sp.	Pearl River Basin, China
Freshwater	Amphibian	Amercan bullfrog	*Rana catesbeiana*	Southern Europe (Portugal to Turkey)
Freshwater	Amphibian	African clawed frog	*Xenopus laevis*	Southern Europe (Portugal to Turkey)
Freshwater	Crustacean	Australian redclaw crayfish	*Cherax quadricarinatus*	Norway inland waters
Freshwater	Crustacean	American red clawed crayfish	*Procambarus clarkii*	Southern Europe (Portugal to Turkey)
Freshwater	Mollusc (gastropod)	Golden apple snail	*Pomacea canaliculata*	Southern Europe (Portugal to Turkey)
Freshwater	Macrophyte	Water fern	*Azolla filiculoides*	Southern Europe (Portugal to Turkey)
Freshwater	Macrophyte	Whorled pennywort	*Hydrocotile verticillata*	Southern Europe (Portugal to Turkey)
Freshwater	Fish	American paddlefish	*Polyodon spathula*	Southern Europe (Portugal to Turkey)
Freshwater	Fish	Striped+white bass hybrid	*Morone chrysops* x *M. saxatilis*	Southern Europe (Portugal to Turkey)
Transitional waters	Fish	Thinlip mullet	*Liza ramada*	Turkish transitional waters
Transitional waters	Fish	Blue catfish	*Ictalurus furcatus*	Chesapeake Bay, USA
Transitional waters	Fish	Round goby	*Neogobius melanostomus*	Baltic Sea
Transitional waters	Crustacean	Chinese mitten crab	*Eriocheir sinensis*	North Sea estuaries
Transitional waters	Cladoceran	Fishhook waterflea	*Cercopagis pengoi*	Baltic Sea
Transitional waters	Serpulid tubeworms	Australian tubeworm	*Ficopomatus enigmaticus*	To be agreed
Transitional waters	Mollusc (bivalve)	Common wedge clam	*Rangia cuneata*	To be agreed
Transitional waters	Brown kelp	Wakame	*Undaria pinnatifida*	To be agreed
Transitional waters	Polychaete worms	Polychaete worms	*Marenzelleria* spp.	To be agreed
Marine	Filamentous red alga	Turf-forming red alga	*Womersleyella setacea*	Mediterranean
Marine	Green alga	Green caviar/Sea grape	*Caulerpa* var. *cylindracea*	Mediterranean
Marine	Green alga	Sea grape	*Caulerpa* var. *racemosa*	All of Europe
Marine	Mollusc (gastropod)	Veined whelk	*Rapana venosa*	All of Europe
Marine	Jellyfish	Warty comb jellyfish	*Mnemiopsis leidyi*	UK coast
Marine	Jellyfish	Nomad jellyfish	*Rhopilema nomadica*	Eastern Mediterranean
Marine	Mollusc (gastropod)	Persian conch	*Conomurex persicus*	Eastern Mediterranean
Marine	Mollusc (gastropod)	Slipper limpet	*Crepidula fornicata*	Ireland & Britain
Marine	Mollusc (bivalve)	Pharaoh's Red Sea mussel	*Brachidontes pharaonis*	Eastern Mediterranean
Marine	Crustacean (Copepoda)	Calanoid copepod	*Acartia tonsa*	Svalbard/Spitzbergen archipelago
Marine	Mollusc	Suminoe oyster	*Crassostrea ariakensis*	US Atlantic coast
Marine	Crustacean	American lobster	*Homarus americanus*	UK coast
Marine	Tunicate	Carpet sea squirt	*Didemnum vexillum*	Atlantic Canada
Marine	Tunicate	Carpet sea squirt	*Didemnum vexillum*	Atlantic USA
Marine	Fish	Dusky spinefoot	*Siganus luridus*	Eastern Mediterranean
Marine	Fish	Lionfish	*Pterois volitans*	Ireland & Britain
Marine	Crustacean (Malacostracan)	Tiger prawn	*Penaeus pulchricaudatus*	Eastern Mediterranean
Marine	Rabbit fish	Marbled spinefoot	*Siganus rivulatus*	Mediterranean

The second groups of assessments will explore how the risk ranking of a species can vary among assessors and according to risk assessment area. The results obtained will be analysed and reported in a manuscript for submission to an international peer-reviewed journal sometime during 2016.

4.3 Term of Reference c)

Continue identification and evaluation of climate change impacts on the establishment and spread of NIS. Finalise global review on salinity change effects on non-indigenous species (joint Term of Reference with WGBOSV); (ToR lead Nathalie Simard)

Addressing this ToR was started with two presentations examining the biological introduction risks from shipping in a warming Arctic and a review of research and monitoring activities for ship-mediated nonindigenous species in the Canadian Arctic.

Update on Biological introduction risks from shipping in a warming Arctic *(by Anders Jelmert, Chris Ware et al.)*

Seventeen ballast water samples from eight vessels (two samples per ship plus one control sample), were collected at ports in Svalbard in 2011. Voyage length ranged from 7 to 22 days (mean = 10.2, SE = 1.7) Mean = 1522 ± 335 SE individuals m^{-3}, predominately comprised of indigenous species. Non-indigenous coastal species were present in all except one of 17 ballast water samples (mean = 144 ± 67 SE individuals m^{-3}) despite five of the eight ships exchanging ballast water *en route*. Operational Taxonomic Units and species identification by microscopy and molecular methods (mtDNA CO1 and 12S and 16S rDNA genes). Of a total of 73 taxa, 36 species including 23 non-indigenous species were identified. Of those 23, sufficient data permitted evaluation of the current and future colonization potential for eight widely known invaders. With the exception of one of these species, modelled suitability indicated that the coast of Svalbard is unsuitable presently; under the 2100 Representative Concentration Pathway (RCP) 8.5 climate scenario, however, modelled suitability will favour colonization for six species. We show that current ballast water management practices (ballast water exchange in Open Ocean) do not prevent non-indigenous species from being transferred to the Arctic highlighting the need for more effective ballast water management measures to protect ballast water recipient environments from new NIS arrivals. Consequences of these shortcomings will be shipping-route dependent, but will likely magnify over time: our models indicate future conditions will favour the colonization of non-indigenous species Arctic-wide.

RESEARCH AND MONITORING FOR SHIP-MEDIATED NON-INDIGENOUS SPECIES IN THE CANADIAN ARCTIC (by Kimberly Howland, Philippe Archambault, Sarah Bailey, David Barber, Louis Bernatchez, Guillem Chust, Valérie Cypihot, Jesica Goldsmit, Anais Lacoursière, Frédéric Laget,George Liu, David Lodge, Jennifer Lukovich, Chris McKindsey, Ernesto Villarino, André Rochon, Nathalie Simard, Pascal Tremblay, Nathalie Simard, Gesche Winkler)

The distribution of taxa along the Canadian Arctic coastline is poorly known, and the extent of non-indigenous species (NIS) incursions in the area is unknown. This lack of information makes it difficult to determine origins of new species and make predictions about impacts to native communities. Thus, much of the research in the Arctic region has focused on obtaining a comprehensive baseline of current native and non-indigenous species diversity in high risk ports and species- specific predictive modelling/ecological risk assessment to identify taxa, geographic regions and pathways with high potential for introduction. Comparisons of recently collected samples from high risk ports with historical species lists indicated the presence of several new benthic marine species for the Canadian Arctic that are considered cryptogenic along with a number of taxa representing new records within the port regions surveyed or the more extended, adjacent surrounding regions. Although no known invasive species were detected in surveys, species distribution modelling under current environmental conditions predicted that at least three of eight candidate high risk benthic invasive species, have suitable habitat conditions for survival and reproduction in the Hudson Complex and Beaufort Sea regions of the Canadian Arctic. Under future environmental conditions (by mid-century), a northward extension of suitable habitat was predicted in the same regions for all the eight modelled species. These habitat suitability results are now being combined with shipping and habitat sensitivity in an ecological risk assessment framework to evaluate species-specific risk by pathway and year. Preliminary results show that although risk is temporally variable, discharge events from domestic vessels transiting to the Arctic generally pose a higher relative risk than international vessels for Littorina littorea and Mya arenaria, invasive species which are predicted to have suitable habitat under current Arctic conditions.

This ecological risk assessment is being complemented by ongoing experimental research on risks associated with domestic ballast (currently unregulated in Canada) and ballast sampling at high risk ports and new ports expected to have rapid increases in shipping due to resource development. Further research over the next three years will be aimed at developing a basis for a standardized monitoring and early detection program in the Canadian Arctic. The following objectives are designed to extend current research efforts by Fisheries and Oceans Canada and the Canadian Aquatic Invasive Species Network and are funded largely through Polar Knowledge Canada, ArcticNet and Nunavut Wildlife Management Board: 1) Identification and ranking of key ship-mediated AIS for early detection and monitoring, and geographic locations with highest probability for establishment; 2) Development of genetic early detection methodologies (e.g., environmental or eDNA) for AIS in high risk ports; 3) Establishment of a community based monitoring (CBM) nework/capacity. The initial research and training through this study will provide the foundation for establishing an ongoing monitoring program in the Canadian Arctic that should ideally include: 1) research to continually improve monitoring approaches and update invasive species databases; 2) field surveys of existing native taxa, non-indigenous species, and environmental conditions through a combination of both community-based efforts that would be low intensity and regularly scheduled, and scientific efforts of episodic high intensity in key areas; and, 3) ongoing eDNA monitoring for high risk invasive species.

The planned global review on salinity change impacts of NIS was advanced further with identifying the focus and designing the framework. The study will be carried forward and finished intersessionally.

Global review on salinity change effects on non-indigenous species *(by João Canning-Clode)*

In the past four decades, biodiversity has been decreasing as has been shown recently by several biodiversity indicators (Butchart *et al.* 2010). In fact, biological invasions were recently considered as the second most significant driver to cause species extinctions (Bellard *et al.*, 2016).

Recently, the ICES Benthic Ecology Working Group has conceptualized a very complex model of the climate change effects on benthic organisms and benthic interactions (Birchenough *et al.*, 2015). This model clearly shows the influence of increased CO_2 and temperature directly affects abiotic (e.g. salinity, pollution, acidification) and biotic components (e.g. primary production, latitudinal shifts, larval supply). More important, this model shows that the influence of climate change in the marine benthic system is a very complex network of processes. Therefore,

In future years, water temperature will increase due to climate change and this will cause changes in salinity regimes at a global scale. For example climate change will certainly alter local precipitation because the frequency and magnitude of extreme weather events will increase and this will lead to salinity fluctuations. These salinity fluctuations will depend on proximity to river deltas, ice melting and major ocean currents and will affect the distribution of shallow estuarine species.

Following the discussions of the ICES WGITMO meeting in Olbia, Italy, it was decided to produce a global review on mechanisms and patterns of these salinity fluctuations. For this review we will develop a conceptual framework on salinity changes (Figure 4.3.1).

Climate change will generate salinity increases and salinity decreases. For both salinity increases and decreases, we will discuss causes, synergies and possible impacts on benthic assemblages. These processes will be validated and supported with published global examples.

For example, causes for salinity decrease would include the ongoing melting of glacial and sea-ice or increased rainfall events. However, these reported salinity decreases could have been synergetic related with sediments loads. We would also discuss possible impacts of salinity decreases such as depth effects influencing shallow water diversity, composition and abundance.

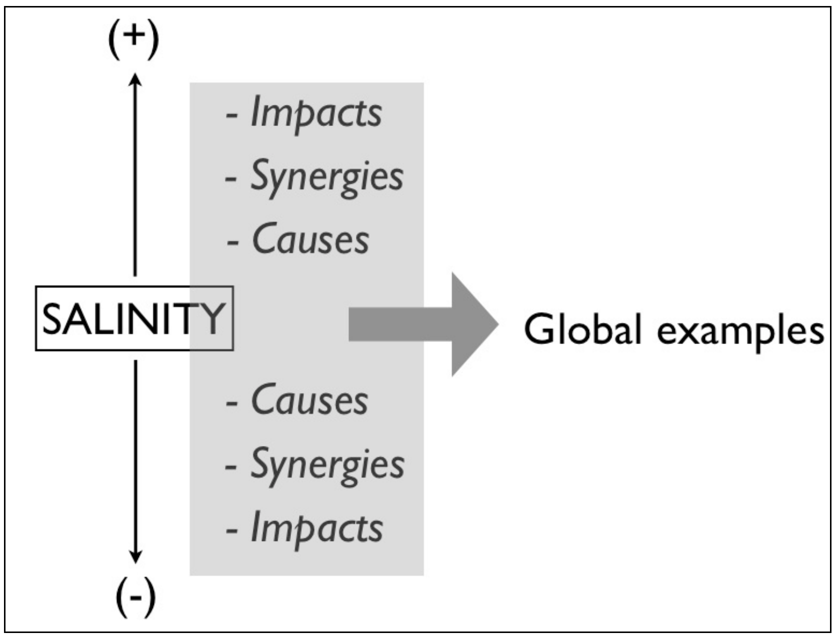


Figure 4.3.1. Conceptual framework on mechanisms and patterns of salinity change effects on non-indigenous species. This general review will focus on salinity fluctuations (both increases and decreases). Causes, synergies and impacts of these fluctuations will be discussed and further validated with examples from several biogeographic regions.

The authors of this manuscript are João Canning Clode – Lead (Portugal), Henn Ojaveer (Estonia), Anna Occhipini (Italy), Jim Carlton (USA), Chad Hewitt (New Zealand), Marnie Campbell (New Zealand), Anders Jelmert (Norway) and Judy Pederson (USA). A draft of this manuscript is expected to circulate among authors during summer 2016 and final submission is expected in December 2016.

References

Bellard C., Cassey P. & Blackburn T.M. (2016) Alien Species as a Driver of Recent Extinctions. Biology Letters 12 (in print)

Birchenough S.N.R., Reiss H., Degraer S., Mieszkowska N., Borja Á., Buhl-Mortensen L., Braeckman U., Craeymeersch J., De Mesel I., Kerckhof F., Kröncke I., Parra S., Rabaut M., Schröder

A., Van Colen C., Van Hoey G., Vincx M. & Wätjen K. (2015) Climate change and marine benthos: a review of existing research and future directions in the North Atlantic. *Wiley Interdisciplinary Reviews: Climate Change*, **6**, 203–223.

Butchart S.H.M., Walpole M., Collen B. and 42 co-authors (2010) Global biodiversity: Indicators of recent declines. Science, **328**, 1164–1168

Copp G.H. (2013) The Fish Invasiveness Screening Kit (FISK) for non-native freshwater fishes – a summary of current applications. Risk Analysis, 33, 1394–1396.

Copp G.H., Russell I.C., Peeler E.J., Gherardi F., Tricarico E., MacLeod A., Cowx I.G., Nunn A.D., Occhipinti Ambrogi A., Savini D., Mumford J.D. & Britton J.R. (2016) European Non-native Species in Aquaculture Risk Analysis Scheme – a summary of assessment protocols and decision making tools for use of alien species in aquaculture. Fisheries Management & Ecology, 23, 1–11.

Copp G.H., Vilizzi L., Tidbury H., Stebbing P.D., Tarkan A.S., Moissec L. & Goulletquer Ph. (unpublished). A generic decision-support tool for identifying potentially invasive aquatic taxa: AS-ISK. (submitted manuscript)

Lawson L.L., Vilizzi L., Hill J.E., Hardin S. & Copp G.H. (2013) Revisions of the Fish Invasiveness Screening Kit (FISK) for its application in warmer climatic zones, with particular reference to peninsular Florida. Risk Analysis, 33, 1414–1431.

Addressing the Proposed demonstration advice

WGITMO/WGBOSV jointly discussed and developed questions that could direct the development of demonstration advice on "risk management of non.indigenous species associated with shipping in the Arctic", in response to a direct request received from ICES Bureau shortly before the meeting was held. The Groups reviewed recent activities at ICES related to the development of demonstration advice within strategic priority areas. Given that the ICES strategic plan commits to further develop its science and advisory capacity for the Arctic, and that multiple individual WGBOSV/WGITMO members have received requests for information directly from groups working on non-native species issues under the Arctic Council, the Groups jointly agreed to submit three questions for consideration as material for development of demonstration advice:

1) How will climate change impact the risk of introduction, survival and/or establishment of marine non-native species in the Arctic?
2) What management measures currently available in other marine environments are applicable for the Arctic?
3) What future activities should be prioritized to manage marine NIS in the Arctic?

A subset of members from both Groups expressed interest to draft a paper addressing these questions prior to the next meeting. Finally, the Groups reviewed the objectives of the Arctic Council with respect to invasive species, discussed the lack of coordination between the different international groups working on non-native species issues in the Arctic, and the uncertain role of WGBOSV/WGITMO experts that are feeding the same scientific input to multiple end-users. It was recommended that ICES leadership should initiate discussion/coordination with other Arctic organisations (e.g. PAME, CAFF) with a view to address non-native species issues in the Arctic jointly with all organisations active in this field.

IMPACTS OF CLIMATE CHANGE ON NIS IN THE Baltic Sea ***(by Maiju Lehtiniemi)***

Biological invasions coupled with climate change drive changes in marine biodiversity. Warming climate and changes in hydrology may either enable or hinder the spread of non-indigenous species (NIS) and little is known about how climate change modifies the richness and impacts of NIS in specific sea areas. We calculated from climate change simulations the changes in summer time conditions which northern Baltic Sea may go through by the end of the 21st century, e.g. 2–5°C sea surface temperature rise and even up to 1.75 unit decrease in salinity. We reviewed the temperature and salinity tolerances (i.e. physiological tolerances and occurrence ranges in the field) of pelagic and benthic NIS established in - or with dispersal potential to – the northern Baltic Sea, and assessed how climate change will likely affect them. Our findings suggest future changes in several NIS distributions in the coastal areas of the northern Baltic Sea. Salinity decrease acts as a major driver for NIS biogeography in the northern Baltic Sea, but temperature increase and extended summer season allow higher reproduction success in many species.

Literature:

Holopainen R, Lehtiniemi M, Meier M, Albertsson J, Gorokhova E, Kotta J, Viitasalo M. 2016. Impacts of changing climate on the non-indigenous invertebrates in the northern Baltic Sea by end of the 21st century. In press. Biological Invasions

4.4 Term of Reference d)

Continue investigating NIS associated with biofouling, incl. those on artificial hard structures in the marine environment and recreational boating (joint Term of Reference with WGBOSV); (ToR lead Cynthia McKenzie)

Addressing the ToR was started with a review of the Guidelines and Guidance developed by the International Maritime Organization for control and management of ships' biofouling to minimize the transfer of aquatic non-native species by commercial ships and recreational boats. On the joint meeting day, an overview was presented of recent activities conducted to assess the risk of biofouling by recreational boats across Canada. Finally, a presentation was contributed about marine infrastructures as corridors for non-native species and how changes in engineering of structures could serve to limit spread. The Groups identified key external researchers to invite to next year's meeting in order to expand relevant expertise. The Groups noted that the International Maritime Organization highlighted research needs related to management of biofouling and that the Groups could prepare and submit relevant information in the future.

REVIEW OF IMO GUIDELINES ON BIOFOULING (by Cynthia McKenzie, Terri Wells and Haley Lambert)

The IMO Adopted the 2011 Guidelines for Control and Management of Ships Biofouling to Minimize the Transfer of Invasive Aquatic Species. (Annex 26 Resolution MEPC.207 (62) Adopted 15 July 2011). Biofouling procedures should be effective, practical, cost efficient and environmentally safe. Measures outlined include:

1) Creation of a biofouling management plan and record book (see IMO, 2011 Appendix 1 for format and content)

2) Vessel surface preparation and use of an antifouling system (special attention to vessel niche areas)

3) Retention of biological, chemical and physical pollutants from cleaning and maintenance periods

4) In water inspections are recommended (dive or ROV)

5) New vessels should be designed to facilitate easy inspection and treatment

6) Ships should be provided with biofouling management information through the appropriate authority

Other Resolutions and Guidelines for Antifouling Systems listed by the IMO include:

Resolution 1 - Early and effective application of the Convention – This resolution requests Member States to prepare to be bound by the Convention and urges relevant industries to refrain from marketing, sale and application of the substances controlled by Annex 1 of the Convention (ie. ban of organotin compounds which act as biocides). The list of antifouling systems to be prohibited or controlled will be updated in Annex 1 when necessary.

Resolution 2 - Future work of the Organization pertaining to the Convention – The resolution invites IMO to develop guidelines for brief sampling of anti-fouling systems; guidelines for inspection of ships; and guidelines for surveys of ships.

The following have been developed and adopted:

- Guidelines for survey and certification of anti-fouling systems on ships - adopted by resolution MEPC.102(48), superseded by resolution MEPC.195(61);
- Guidelines for brief sampling of anti-fouling systems on ships - adopted by resolutionMEPC.104(49); and
- Guidelines for inspection of anti-fouling systems on ships - adopted by resolution MEPC.105(49), superseded by resolution MEPC.208(62).

Guidance on best management practices for removal of anti-fouling coatings from ships, including TBT hull paints(AFS.3/Circ.3).

Resolution 3 - Approval and Test Methodologies for Anti-Fouling Systems on Ships

Resolution 4 - Promotion of Technical Co-operation – The resolution requests IMO Member States to promote and provide directly, or through IMO, support to States in particular developing States that request technical assistance for: the assessment of the implications and compliance with the Convention; the development of national legislation the introduction of other measures

The IMO Approved the Guidance for Minimizing the Transfer of Invasive Aquatic Species as Biofouling (hull fouling) for Recreational Craft (IMO, 2012, Annex MEPC.1/Circ.792, 12 November 2012)

1) The Marine Environmental Protection Committee, at its sixty-fourth session (1 to 5 October), approved the guidance for minimizing the transfer of invasive aquatic species as biofouling (hull fouling) for recreational craft [vessels less

than 24 m in length] (see MEPC 64/23 paragraph 11.8) developed by the Sub-Committee on Liquids and Gases at its sixteenth session (30 January to 3 February 2012) as set out in the annex.

2) Member Governments are invited to bring the circular to the attention of all parties concerned.

The presentation also included a review of biofouling activities currently planned on in place particularly in Australia, New Zealand, the United States, Canada and Ireland. The Global Oil and Gas Industry Association for Environmental and Social Issues & International Association of Oil & Gas Producers (OPIECA/OGP) - London, UK also have guidelines for their industry which were discussed. Current biofouling response treatments or strategies include mechanical cleaning methods in water and on land, electrochemical/ electrical /powered methods as well as chemical treatments.

The IMO Guidelines identify Research needs (12.1) (Annex 26 Resolution MEPC.207 (62))

1) Minimizing and/or managing both macrofouling and microfouling particularly in niche areas;
2) In-water cleaning that ensures effective management of the antifouling system, biofouling and other contaminants, including effective capture of biological material;
3) Comprehensive methods for assessing the risks associated with in-water cleaning;
4) Shipboard monitoring and detection of biofouling;
5) Reducing the macrofouling risk posed by the dry-docking support strips;
6) The geographic distribution of biofouling invasive aquatic species;
7) The rapid response to invasive aquatic species incursions, including diagnostic tools and eradiation methods.

The IMO guidelines also request Independent Information. (Annex 26 Resolution MEPC.207(62))

> 12.3 Summaries are needed of the different types of anti-fouling systems and other biofouling management measures currently available, how they work and their performance under different operating conditions and situations. This information could assist shipowners and operators when making decisions about the most appropriate coatings and coating systems for their ship type and activity.

These IMO research needs and independent information request may provide a role for WGBOSV and this role and future research /information for international biofouling was discussed.

Canadian National Risk Assessment of Biofouling by Recreational Boats *(by Cynthia McKenzie and Nathalie Simard)*

Fisheries and Oceans Canada conducted a National Risk Assessment to collect and provide scientific advice on the risk that recreational boating, as a vector for the introduction and spread of AIS, poses to Canadian fresh and marine waters. The objectives of the study were to determine: 1) The risk posed by recreational boating in Canadian marine waters on both the east and west coasts. a.) Characterization of movement patterns of recreational boats in marine waters within and between ecoregions and b) estimate potential risk to marine ecoregions considering vessel characteristics, their movements, environmental similarity, and AIS sources; 2) The ecological risk posed by recreational boating in the Great Lakes Basin. Quantify the characteristics of AIS spread by recreational boats within and among the Great Lakes proper, including an assessment of the relative probabilities of spread and establishment among different ports/marinas supporting boating activity. And finally, 3) The current state of knowledge about the ecological risk posed by recreational boating as a vector of overland AIS movement between inland lakes in Canada. Three research documents were produced and assessed at a meeting in Montreal in December 2015.

The first document was a "National Risk Assessment of Recreational Boating as a Vector for Marine Non-indigenous Species" by Simard, N., *et al.* 2016. National Risk Assessment of Recreational Boating as a Vector for Marine Non indigenous Species. DFO Can. Sci. Advis. Sec. Res. Doc. 201X/nnn. vi + 114 p. Results of this assessment determined that primary introduction and secondary spread of NIS may result from recreational boating in all Canadian marine ecoregions, however only a small proportion have an intermediate or high risk. Although most ecoregions have lower risk they may still receive transient boats of a higher risk. High connectivity among marinas in all ecoregions and among ecoregions; these boats are very likely to transport NIS to other marinas. Final Ecoregion Invasion Risk scores were greater for the Pacific Region than the Atlantic Region. Regional differences greatly influenced by seasonality of boating activities (time in water, maintenance, boating activity) and sheer number of boats. This was a relative risk study and low risk does not indicate no risk.

The second document was "Ecological Risk Assessment of Recreational Boating as a Pathway for the Secondary Spread of AIS in the Great Lake Basin" by D.A.R. Drake, S.A. Bailey, N.E Mandrak. This assessment determined that a total of 11.8 Million recreational boating trips occur in the Great Lakes basin each year (3.8 M in Canada, 8.01 M in the United States). The sheer volume of boater activity allows for effective boater mediated spread of AIS in the GLB. When an invasive species is introduced to the GLB, modelling indicates that on-water boating activity can increase the rate of spread of species to new locations compared with natural dispersal. In some cases, this leads to new pathways of dispersal (i.e. to upstream locations) that would be unlikely to occur in the Great Lakes Basin, with presumed high ecological impact.

The final document was a review and addressed the "Overland Spread of Aquatic Invasive Species due to Recreational Boating in Canada" D.A.R. Drake. There is extensive literature pertaining to overland movement of AIS by freshwater recreational boats. Four themes emerged from the literature: contamination of vessels with aquatic species, predicting ecosystems at greatest risk of invasion, survival of species during overland transport, including effectiveness of physical decontamination, and the link between boater behaviours, educational campaigns, and spread management. A large number of boating trips occur through the overland, trailered movement of recreational boats among freshwater ecosystems in Canada each year (estimated at 21 Million). As a result of this large number, even low per-trip probabilities of introduction can lead to a high number of introduction events.

Corridors for aliens but not for natives: challenges and opportunities of an ecologically-based design of marine infrastructures *(by Laura Airoldi)*

Urban sprawl has dramatically expanded across marine seascapes. Throughout history, marine infrastructures have expanded, shorelines have been developed and intertidal and shallow subtidal areas have been reclaimed and armoured to meet the growing societal needs of burgeoning coastal populations, and respond to greater threats from climate change, storm surges and sea level rise. These habitat modifications have altered the local to regional distribution of a number of species, including numerous aliens, which can thrive on these anthropogenic surfaces. Recent work has shown that artificial habitats can act as regional corridors for non-indigenous species, while not representing adequate substrata for many native species. I will discuss the structural and environmental factors promoting the colonisation of marine infrastructures by non-indigenous species, the seascape connections between artificial and natural habitats, and the potential of ecological engineering to mitigate some of these impacts. I will show that adequate substrates, transplantation techniques and sound management can be combined to design better constructions that favour the preferential use by native species over non-indigenous ones. I will also discuss the need to incorporate marine habitat enhancement in modern planning, policy and design of cities and waterfronts, where people would directly benefit from the ecological services provided by healthy marine ecosystems, and will introduce a conceptual framework for designing marine developments that provide multifunctional outcomes for the society.

4.5 Term of Reference e)

Finalise draft of the alien species alert report for ICES CRR on Didemnum vexillum (ToR lead Cynthia McKenzie)

Didemnum vexillum Kott (2002) is a high impact global invasive species, native to Japan (Lambert, 2009; Stefaniak *et al.*, 2012). It is general a temperate cold water organisms and its introduced range currently includes New Zealand, both coasts of North America, the Netherlands, France, The United Kingdom, Ireland, the Iberian Peninsula, and Italy (Lambert, 2009; Stefaniak *et al.*, 2012; Ordóñez *et al.*, 2015). Like other invasive ascidians, *D. vexillum* has the capacity to reproduce rapidly, outcompete native species, deteriorate environmental integrity, and cause significant economic harm (Lambert, 2005; Blum *et al.*, 2007; Daniel and Therriault, 2007; Langyel *et al.*, 2009; Cordell *et al.*, 2013). For these reasons, this alien species alert report aims to increase awareness of *D. vexillum*, with focus on identification, natural history, current global distribution, potential impacts, and prospects for management and control where introductions occur.

4.6 Term of Reference f)

Evaluate the role/importance of different bioinvasion vectors and pathways globally (ToR lead Henn Ojaveer)

Contributions to this ToR had both a regional and a vector-specific approach. Some of the presentations and discussions were held jointly with WGBOSV while a few specific issues were presented and discussed at the WGITMO meeting only.

The relative importance of different vectors of aquatic non-native species in the Baltic Sea; of the Suez Canal and recreational boating as a vectors for introductions to the Mediterranean Sea; and of tsunami debris as vector of non-native species to the Pacific coast of North America were examined. The Group discussed how the relative importance of vectors has differed through time and by region, and how it could be valuable to conduct a global review on the topic. Concerns were raised about the lack of standardized data across regions, and the uncertainty surrounding the date of first report for introductions and the accurate assignment of responsible vectors. The Group noted that climate change and evolutionary responses of non-native species were important factors to consider when assessing future risk of new introductions.

Baltic Sea Pathways *(by Henn Ojaveer)*

In total, findings of 132 NIS and CS, with in total 440 introduction events have been documented in the Baltic Sea. Germany has the highest (66) and Lithuania the lowest (33) number of recorded NIS/CS introductions. On average, 27 NIS/CS are currently established (with min/max of 20 and 42 species in Latvia and Germany, respectively) while 13 species have been unable to establish self-sustaining populations (Table 4.6.1).

Table 4.6.1. Status of non-indigenous and cryptogenic species in the Baltic Sea by countries until the end of 2015.

Country/region	Total/established
Denmark	39/25
Estonia	34/25
Finland	45/24
Germany	66/42
Latvia	40/20
Lithuania	33/22
Poland	56/32
Russia/Kaliningrad	43/26
Russia/St. Petersbourg	38/21
Sweden	49/31
Average	**44/27**

Benthic invertebrates strongly dominate both in terms of introductions recorded as well as established species (63 and 46 species, respectively). Despite relatively high introduction records of fish (32 species), only five of them (gibel carp *Carassius gibelio*, rainbow trout *Onchorhyncus mykiss*, round goby *Neogobius melanostomus*, Chinese (Amur) sleeper *Percottus glenii* and common carp *Cyprinus carpio*) have been able to form self-sustaining populations in at least one Baltic country. The number of NIS/CS by all other organism groups (i.e., phytoplankton, phytobenthos, zooplankton, parasites) remains below ten species.

The most important introduction pathways (including both primary introductions and secondary spread) over time have been vessels (38.6%), then stocking (27.5%) and natural spread of NIS/CS from neighbouring regions (24.8%). While vessel and natural spread mediated introductions have been important in most time-periods, the role of stocking (of several commercial fish such as for the sturgeons *Huso huso*, *Acipenser baeri*, *A. guledenstaedtii*, *A. stellatus* and *A. oxyrinchus*, and Pacific salmonids *Onchorhyncus keta*, *O. gorbusha*, *O. kisutch* and *O. tsawytscha*) clearly dominated during 1930–1989. This was also an important pathway prior to 1900 (introductions of *A. ruthenus*, *Carassius gibelio*, *Cyprinus carpio*, *Crassostrea virginica*, *Oncorhynchus mykiss*, *Orconectes limosus* and *Salvelinus fontinalis*). Notably, the role of canals has always been small (Figure 4.6.1), with the overall period mean of 5%. As most deliberate fish introductions have been unsuccessful, vessels and natural spread are the most important pathways for the currently established species.

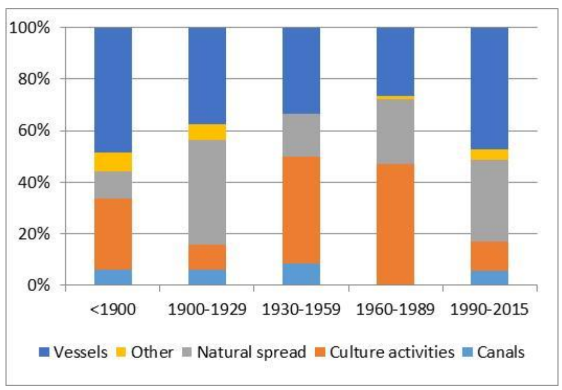


Figure 4.6.1. Relative importance of pathways (%) responsible for species invasions into the Baltic Sea over time.

The level of certainty in affiliating the responsible pathway for a primary introduction requires special attention. It appears that only in 14% of cases (29 out of the total of 214 primary introduction events) we know the introduction pathway with the highest level of confidence, i.e., there is a direct evidence. In 21% of the cases, the pathway could be assigned at a relatively high confidence level (very likely), while in the majority of cases (52%) only the possible pathway is known. In the case of 28 introduction events, the pathway remains unknown. During the first two time periods, confidence levels were lower (Figure 4.6.2).

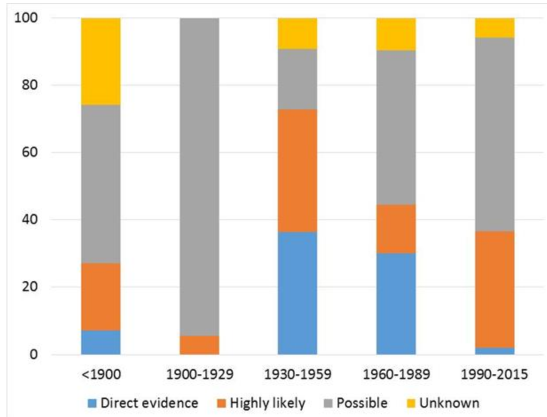


Figure 4.6.2. Relative level of certainty (%) in assigning pathways for primary introduction events into the Baltic Sea by five time-periods.

Literature:

Ojaveer, H., Olenin, S., Narščius, A., Florin, A.-B., Ezhova, E., Gollasch, S., Jensen, K.R., Lehtiniemi, M., Minchin, D., Normant-Saremba, M. and Strāke, S. Dynamics of biological invasions and pathways over time: a case study of a temperate coastal sea (Biological Invasions, under review).

Eyes wide shut – Shipping and the environmental impacts of the enlargement of the Suez Canal *(by Bella Galil)*

Non-indigenous species (NIS) richness differed among European seas, and was substantially greater for the Mediterranean than the Western European margin (WEM) or Baltic Sea, moreover, between 1970 and 2013, the number of recorded NIS has grown by 86, 173 and 204% in the Baltic, WEM and the Mediterranean, respectively (Galil *et al.* 2014). The most common vectors in the Baltic were likely culture (47%) and vessels (39%); in the WEM vessels (45%) and culture (35%); and in the Mediterranean, the Suez Canal (53%) and vessels (24%), though the relative importance of vectors varies among individual countries. A higher percentage of vessel-introduced NIS is noticeable among the most widespread NIS. Vectors determine the geographical origin and the introduced taxa: in a region where the Suez Canal is the main vector, most NIS are of tropical/ subtropical Indo-Pacific origin and comprise molluscs, fish and crustaceans, i.e. taxa actively spreading as adults or more passively transported as larvae. In regions where vessels and mariculture are the prevailing vectors, the taxonomic composition and native ranges of NIS are more diverse and depend on shipping routes and culture trades (Galil *et al.* 2016).

The Suez Canal is one of the most important waterways in the world, it is also the most potent corridor for invasions by marine species. The individual and cumulative impacts of these invasions adversely affect the conservation status of particular species and critical habitats, as well as the structure and function of ecosystems and the availability of natural resources. Some species are noxious, poisonous, or venomous and pose clear threats to human health (Galil *et al.* 2015). The recent enlargements of the Suez Canal increase the influx of NIS. While global trade and shipping are vital to society, there is an urgent need to minimize unwanted impacts and long term consequences affecting fisheries, tourism, human health and the wellbeing of the Mediterranean Sea and its biota.

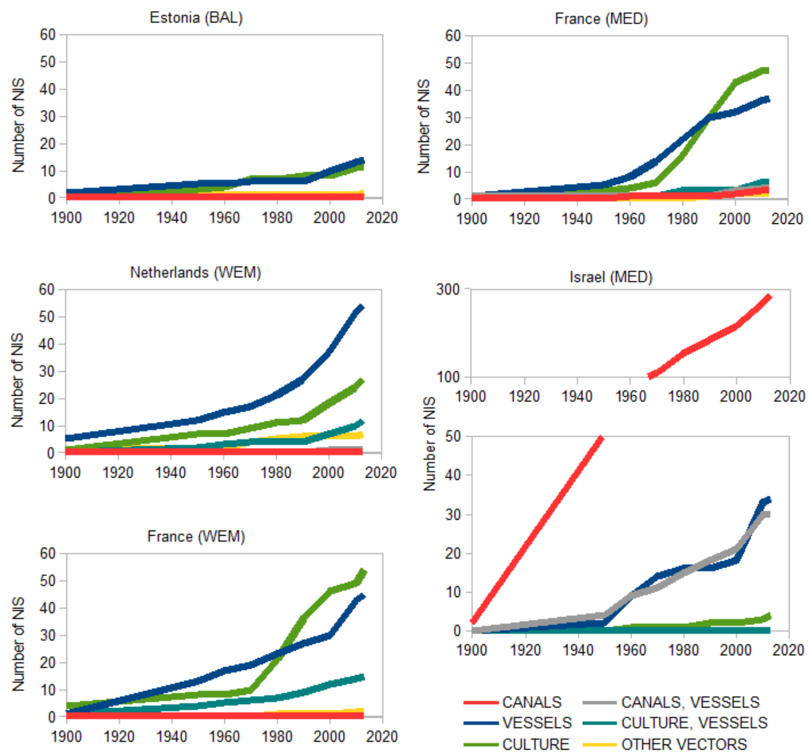


Figure 4.6.3. Cumulative number of non-indigenous species (NIS) by likely vector and country (from Galil *et al.* 2014).

Literature

Galil BS, Marchini A, Occhipinti-Ambrogi A, Minchin D, Narščius A, Ojaveer H, Olenin S. 2014. International arrivals: widespread bioinvasions in European seas. Ethology Ecology & Evolution 26(2–3), 152–171

Galil B, Boero F, Fraschetti S, Piraino S, Campbell M, Hewitt C, Carlton J, Cook E, Jelmert A, Macpherson E, Marchini A, Occhipinti-Ambrogi A, Mckenzie C, Minchin D, Ojaveer H, Olenin S, Ruiz G. 2015. The enlargement of the Suez Canal and introduction of non-indigenous species to the Mediterranean Sea. Limnology and Oceanography Bulletin 24(2), 41–43

Galil BS, Marchini A, Occhipinti-Ambrogi A. 2016. East is East and west is west? Management of marine bioinvasions in the Mediterranean Sea. Estuar Coast Mar Sci doi:10.1016/j.ecss.2015.12.021

Effects of marine debris caused by the Great Tsunami of 2011

(by Thomas Therriault, Hideaki Maki, Nancy Wallace, Cathryn Clarke Murray and Alex Bychkov)

The magnitude 9.0 Great East Earthquake in Japan on 11 March 2011 created a massive tsunami, which washed an estimated 5 million tons of debris out into the Pacific Ocean. According to estimates by the Government of Japan, 70% of that debris sank close to shore leaving at least 1.5 million tons floating in the Pacific Ocean. Japanese tsunami marine debris (JTMD) quickly reached the Hawaiian Islands and less than a year after the earthquake tsunami debris started making landfall on the west coast of North America with debris expected to continue to arrive for years to come. The goal of this 3-year

PICES project funded by the Ministry of the Environment of Japan starting in 2014 is to assess the potential impacts of Japanese tsunami debris on ecosystems on the west coast of North America and Hawaii, including the potential threat from nonindigenous species (NIS). In order to do this our project is focused around three major themes: modelling debris transport; surveillance and monitoring; and NIS research and risk assessment. Modelling efforts have focused on developing forecasts of JTMD distributions and timelines of its arrival on the US/Canada West Coast and in Hawaii by calibrating models using available observational reports. Lighter objects with more windage (e.g. Styrofoam) arrived quickly while heavier objects with less windage (e.g. docks, vessels) continue to arrive. Given vast and remote shorelines where JTMD could make landfall part of the surveillance and monitoring theme has focused on conducting aerial flights of coastal shorelines to identify potential JTMD collector beaches. Combined with monitoring efforts it has been possible to characterize debris landings attributable to the tsunami. In addition to the potential impacts of the debris itself, there is a possible threat due to NIS. Our project has been characterizing this unique invasion vector via direct sampling of JTMD items and using this information in both vector and screening-level risk assessments. To date, almost 300 invertebrate and more than 70 algal species have been found associated with JTMD arriving in North America and Hawaii. In addition, previous NIS work within PICES by WG-21 has proven invaluable, especially the database and Atlas that includes information on 747 NIS in the North Pacific.

ALIEN SPECIES AND HUMAN ACTIVITIES IN ITALIAN COASTAL WATERS, A MARRIAGE TO BE KEPT IN CLOSE CHECK: THE CASE OF TARANTO SEAS *(by Ester Cecere, Fernando Rubino, Antonella Petrocelli)*

Taranto is a paradigmatic case for biological pollution, since this area is heavily subject to all the known factors of risk. Indeed, the Taranto seas have always been the seat of economic activities, which favoured the introduction of alien species, e.g. port activities, mussel farming, and yachting.

The first evidence of alien species in the Taranto seas dates back to the 1920s, with the seaweed *Solieria filiformis* (Kützing) Gabrielson (Rhodophyta, Gigartinales), collected in the Mar Piccolo in 1922 and misidentified as the native *Gracilaria confervoides* Greville. From the second half of the 90s the phenomenon burst, and this resulted in 47 species belonging to different taxa of both marine invertebrates and algae to date.

Starting from 2001, several research projects were carried out, to detect any possible new alien, the likely activities and vectors of introduction and the possible suggestions to avoid new entries in the Taranto seas. In particular, within the framework of “IMSAT – Detection and monitoring of Alien Species in the Taranto Seas”, the first attempt in Italy of direct sampling of ballast waters from ship ballast tanks was performed. Four species of microalgae, never reported for the Taranto seas, were found in ballast waters and ballast sediments. Moreover, four species of invertebrates and three species of seaweeds were detected. As a result of the project, a leaflet was produced and distributed to Italian marine captaincies, local fishermen, mussel farmers and other categories of stakeholders, to make them acquainted about the issue of alien species and inform them about «good practices» to avoid and/or restrict the phenomenon.

In the V.E.C.T.O.R. project, two new aliens were detected, and a comparison between the behaviour of cold temperate species and warm species was performed. The failure of the establishment of the cold temperate seaweed *Undaria pinnatifida* (Harvey) Suringar was highlighted.

In the last years, the number of aliens noticeably increased, and several new introduced species were recorded within the framework of the Flagship Project “RItMARE – Italian Research for the sea”. This project, in which a citizen science experiment was attempted, led to the achievement of important information about the number of cargoes arrived into the Taranto port with BOB in the period 2009–2012, as well as about the quantities of edible molluscs imported from foreign countries. As a result, it was apparent that ballast waters and imported molluscs are confirmed as the most probable vectors for the introduction of aliens in the Taranto seas.

However, most importantly, it was evident that the bad practices of local sea stakeholders make higher the risk of alien introduction because:

- pending sale, the operators may store the shellfish in the sea, facilitating the introduction of aliens, while breaking European law for the production and sale of live bivalves;
- oyster valves and packing thalli are usually jettisoned into the sea;
- except for a few mussel farmers, stakeholders seem to be unaware of the measures by European Council Regulation on the use of alien and locally absent species in aquaculture.

Recreational Boating as a vector of introduction of marine non-indigenous species in the Mediterranean Sea (*by Anna Occhipinti-Ambrogi)*

A first estimate of the role of recreational marinas as hubs for marine NIS has been carried out in 2013/14 along the western coast of Italy, in the framework of a PhD project recently accomplished at University of Pavia, supervised by Anna Occhipinti and Agnese Marchini (PhD student: Jasmine Ferrario). The fouling assemblages in commercial harbours and recreational marinas were examined in five provinces of Liguria, Tuscany and Sardinia. Results indicated that marinas exhibit comparable (in a few cases higher) number of NIS than harbours, and NIS that do not occur in harbours, indicating that marina habitats represent high-risk sites of introduction of NIS, and deserve urgent attention from scientists and management. A survey on the habits (hull maintenance, travel history) of Italian recreational boaters was also performed, and allowed us to detect a low level of awareness about the problem of marine NIS.

A further PhD project is currently ongoing at University of Pavia, in collaboration with UPMC Paris and HCMR Crete, in the framework of the Doctoral Programme on Marine Ecosystem Health and Conservation MARES (PhD student: Aylin Ulman). This project includes analysis on fouling assemblages from marinas as well as recreational boat hulls at a Mediterranean-wide scale (France, Italy, Malta, Greece, Cyprus, Turkey).

4.7 Other discussion items and any other business

4.7.1 Election of the chair

Cynthia McKenzie (Canada) was unanimously elected as the next chair of WGITMO.

4.7.2 Assessing biological invasions in European seas: biological traits of the most widespread non-indigenous species (by Alice Cardeccia)

The biological traits of the sixty-eight most widespread multicellular non-indigenous species (MWNIS) in European Seas: Baltic Sea, Western European Margin of the Atlantic Ocean and the Mediterranean Sea were examined. Data for nine biological traits was analyzed, and a total of 41 separate categories were used to describe the biological and ecological functions of these NIS.

Our findings show that high dispersal ability, high reproductive rate and ecological generalization are the biological traits commonly associated with MWNIS. The functional groups that describe most of the 68 MWNIS are: photoautotrophic, zoobenthic (both sessile and motile) and nektonic predatory species. However, these 'most widespread' species comprise a wide range of taxa and biological trait profiles; thereby a clear "identikit of a perfect invader" for marine and brackish environments is difficult to define. Some traits, for example: "life form", "feeding method" and "mobility", feature multiple behaviours and strategies. Even species introduced by a single pathway, *e.g*. vessels, feature diverse biological trait profiles.

MWNIS likely to impact community organization, structure and diversity are often associated with brackish environments. For many traits ("life form", "sociability", "reproductive type", "reproductive frequency", "haploid and diploid dispersal" and "mobility"), the categories mostly expressed by the impact-causing MWNIS do not differ substantially from the whole set of MWNIS.

Literature

Cardeccia A., Marchini A., Occhipinti-Ambrogi A., Galil B., Gollasch S., Minchin D., Narščius A., Olenin S., Ojaveer H. (2016) Assessing biological invasions in European Seas: Biological traits of the most widespread non-indigenous species. *Estuarine, Coastal and Shelf Science* (in press), http://dx.doi.org/10.1016/j.ecss.2016.02.014

4.7.3 *Caulerpa cylindracea* in the Mediterranean Sea: an overview (by Giulia Ceccherelli)

The spread of the green macroalga *Caulerpa cylindracea* is one of the most threatening invasions in 17 countries of the Mediterranean Sea. Many correlative and experimental studies focused on different aspects of *C. cylindracea* invasion. This effort aims to evaluate the main factors influencing the spread of the alga through an overview of the results obtained in 45 papers on this topic; a critical analysis led to the development of a conceptual model. Mechanical destruction of habitats and the increase in sedimentation and nutrient concentration in the water column resulted to directly enhance the *C. cylindracea* spread. Indirect effects due to factors leading to loss of canopy species, to spread of turf-forming algae, and to decrease in substrate complexity were also evidenced. A complex net of interactions between abiotic and biotic factors was also drawn whose importance in influencing *C. cylindracea* spread is discussed. The conceptual model provides a tool for addressing specific hypotheses in future studies and planning conservation programs.

4.7.4 Work in progress: North Sea overview (by Kathe Jensen)

Kathe Jensen presented the outline of a review paper on marine alien species from the Greater North Sea Area. The paper is under preparation by 17 authors from 10 countries, and it will comprise an updated checklist of alien and cryptogenic species, their status, year of first introduction and occurrence in the 8 countries surrounding the Greater North Sea Area. The species list will be based on records from published, peer-reviewed papers and the AquaNIS and NOBANIS databases. Nomenclature will be checked against WoRMS, AlgaeBase and/or FishBase as appropriate. Problematic species, whether by taxonomy, alien status, or occurrence, will be discussed and, if they remain problematic, will be placed on a separate list. We include phytoplankton, zooplankton, macroalgae, higher plants, benthic invertebrates, fishes and eukaryotic parasites. We use the European Environmental Agency definition, also adopted by ICES, of the Greater North Sea Area. However, the actual borders will be discussed in relation to occurrence of alien species. We include coastal waters, estuaries, fjords and lagoons with salinity above 5ppt, as well as open sea. Based on the year of first introduction we identify decadal trends for each country, and we hope to be able to identify “hotspots” for introductions.

4.7.5 Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization (by Amelia Curd)

The protocol on "Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization" (ABS), known as the **Nagoya Protocol**, was adopted in 2010 and signed by 92 countries. The Nagoya Protocol is implemented in Europe by way of Regulation 511/2014 of the European Parliament and the Council (“EU Regulation”) that came into force on 12 October 2014.

Briefly, the EU Regulation applies to access and utilisation of genetic resources, access and utilisation of traditional knowledge associated with such genetic resources and to benefits arising from such utilisation. Genetic resources are genetic materials (of any origin containing functional units of heredity):

- over which the provider country (that is a party to the Nagoya Protocol) has exercised sovereign rights and has in place procedures to access such genetic resource.
- that are accessed by a user (based in a Member State) after the EU Regulation comes into force.

The ABS rules apply when genetic resources, and the traditional knowledge associated with them, are used in research and development for their genetic properties and/or biochemical composition, including through the application of biotechnology. The ABS protocol targets the following actions (non-exhaustive list):

- access to materials present in *ex-situ* collections
- the collection of marine or soil samples for the study of organisms or microorganisms

- studies using traditional knowledge of autochtonous communities, particularly in the field of pharmacopoeia
- access to DNA and RNA samples of non-human origin
- the sampling of plants, animals, bacteria and fungi
- the utilisation of biochemical compounds and pathogen resources

The terms 'research and development' have not been defined and so their ordinary meaning applies. **The term 'research' in particular could be interpreted broadly which means that the application of the Regulation could potentially be far reaching.**

Countries that are signatories to the Protocol are in the early stages of putting in procedures for users to access their genetic resources. Member States (MS) are currently evaluating whether or not they will translate this text into national legislation. Some MS namely France and Spain, are developing retrospective national legislation which is more legally binding than the EU regulation, which will apply to all genetic resources accessed after 12 October 2014 (the date the Nagoya protocol was signed by the EU).

Next Steps

There still remain a lot of unanswered questions on interpretation of the EU Regulation (and the Nagoya Protocol) particularly in relation to the scope of application of the EU Regulation. For example, there is uncertainty around the meaning and scope of the term "utilisation of genetic resources". The Nagoya Protocol and EU Regulation broadly define "utilisation of genetic resources" as "to conduct research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology".

In response, the European Commission has indicated

(http://ec.europa.eu/environment/nature/biodiversity/international/abs/legislation_en.htm) that additional guidance on the interpretation of the Regulation will be developed during 2016 and it is anticipated that focus on the scope and/or application of the Regulation will be clarified in such guidance.

Further information

- The Access and Benefit Sharing Clearing House : https://absch.cbd.int/
- Sharing Nature's Genetic Resources – ABS : http://ec.europa.eu/environment/nature/biodiversity/international/abs/index_en.htm
- The Implementation of the Nagoya Protocol in Europe – where are we now : http://www.lexology.com/library/detail.aspx?g=02de4177-ac59–4a74-baa8-f7fcea49a7c5

4.7.6 ICES-PICES cooperation

PICES representative Thomas Therriault attended the meeting. Although PICES doesn't currently have a counterpart to ICES WGITMO, it was discussed and agreed that joint cooperation is still possible as there is a strong interest from both organizations and invasive species are a global concern.

Three areas of joint interest were identified:

1) Data sharing via AquaNIS platform. AquaNIS already contains info outside Europe, incl. Canada, North West Pacific Region (China, Japan, Korea, Russia, Taiwan) and New Zealand. However, before starting data sharing, data formats should be checked, and if needed, amendments may require in AquaNIS system. PICES Working Group 21 created a database that is no longer supported but has valuable information that should reach interested researchers.

2) Joint statement/short manuscript on data and taxonomic issues in the marine invasion literature. Transparency, verification and open-access are some of the related cross-cutting key isuses, for research, monitoring and management. Judy Pederson and Tom Therriault agreed to take the lead in producing the draft, to be circulated for comments and signatures from all meeting participants.

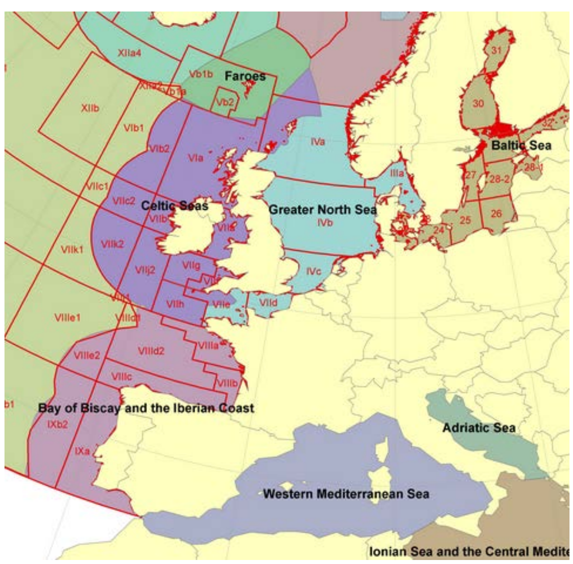
3) Building on previous successes of joint theme sessions on invasive species between the two organizations, it was agreed that a joint ICES-PICES-CIESM session should be organized for an upcoming ICES ASC, perhaps 2017 or 2018.

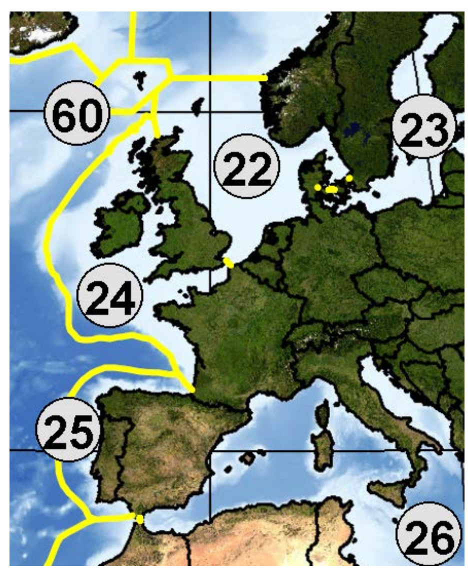
4.7.7 ICES request of further info on NIS

ADGJAMP has recommended that WGITMO and WGBOSV consider drafting a geographically refined list of non-indigenous and cryptogenic species within the ICES area. Lists could be annotated with image data.

AquaNIS uses Large Marine Ecosystems (LMEs) concept for arrangement of marine geographical information; therefore, ICES Ecoregions do not fully overlap with AquaNIS divisions.

ICES ECO-REGIONS	LARGE MARINE ECOSYSTEMS (AQUANIS SYSTEM)





To ensure as close as possible matching the following search criteria were used:

ICES eco-region "Celtic Seas"

[LME 24. Celtic-Biscay Shelf; LME sub-region: Celtic seas; Country: Ireland] OR [LME: 24. Celtic-Biscay Shelf; LME sub-region: Celtic seas; Country: United Kingdom (Britain)]

ICES eco-region "Greater North Sea"

[LME: 22. North Sea] OR [LME: 24. Celtic-Biscay Shelf; LME sub-region: English Channel]

ICES eco-region "Bay of Biscay & Iberian coast"

[LME: 24. Celtic-Biscay Shelf; LME sub-region: Biscay Gulf] OR [LME: 25. Iberian Coastal]

ICES eco-region "Baltic Sea"

[LME 23]

The information is now available for one ecoregion – the Baltic Sea (see Annex 5).

4.7.8 Timing of WGITMO meetings

WGITMO usually meets from Wednesday to Friday with Wednesday as joint meeting day with WGBOSV. However, several people start already leaving the meeting Friday afternoon, so effectively the group has only 2.5 meeting days. Given the very high number of participants recently, the time was considered insufficient. Therefore, it was agreed, that WGITMO will meet every second year from Monday to Wednesday with Wednesday as joint meeting day with WGBOSV.

5 Closing of the meeting

The meeting was closed at 15:00 on 18 March 2016. The chair thanked the group for all their input and participation during the meeting and intersessionally. The chair also thanked Anna Occhipinti-Ambrogi for hosting the meeting.

Annex 1: List of participants

Name	Address	Email
Agnese Marchini	Department of Earth and Environmental Sciences, University of Pavia Via S. Epifanio 14, I-27100 Pavia ITALY	agnese.marchini@unipv.it
Aldona Dobrzycka-Krahel (by correspondence)	Department of Experimental Ecology of Marine Organisms, Institute of Oceanography University of Gdańsk Al. Marszałka Piłsudskiego 46, 81–378 Gdynia, POLAND	oceadk@ug.edu.pl
Alice Cardeccia	Department of Earth and Environmental Sciences, University of Pavia Via S. Epifanio 14, I-27100 Pavia ITALY	alice.cardeccia01@universitadipavia.it
Amelia Curd	IFREMER Centre de Brest BP 70 - F-29280 Plouzané FRANCE	amelia.curd@ifremer.fr
Ann-Britt Florin (By Correspondence)	Swedish University of Agricultural Sciences Kustlaboratoriet, Skolgatan 6 742 42 Öregrund, SWEDEN	ann-britt.florin@slu.se
Anna Occhipinti-Ambrogi	Department of Earth and Environmental Sciences, University of Pavia Via S. Epifanio 14, I-27100 Pavia ITALY	occhipin@unipv.it
Anna Szaniawska (by correspondence)	Department of Experimental Ecology of Marine Organisms, Institute of Oceanography University of Gdańsk Al. Marszałka Piłsudskiego 46, 81–378 Gdynia, POLAND	szaniawska@ug.edu.pl
Anders Jelmert	Institute of Marine Research Flødevigen Marine Research Station 4817 His NORWAY	anders.jelmert@imr.no
Andrea Sneekes (By Correspondence)	Wageningen IMARES Wageningen Imares P.O. Box 57 NL-1780 AB Den Helder THE NETHERLANDS	andrea.sneekes@wur.nl
Anaïs Rey		arey@azti.es
Anna Occhipinti-Ambrogi	Universita degli Studi di Pavia Dipartimento di Ecologia del Territorio Via S. Epifanio 14, I 27100 Pavia, ITALY	occhipin@unipv.it

Bella Galil	National Institute of Oceanography, Israel Oceanographic and Limnological Research, Tel Shikmona, P.O. Box 8030, Haifa 31080 ISRAEL	bella@ocean.org.il
Cynthia McKenzie	Fisheries and Oceans Canada, Northwest Atlantic Fisheries Center P.O. Box 5667, St John 's, NL, A1C 5X1 CANADA	cynthia.mckenzie@dfo-mpo.gc.ca
Dan Minchin	3 Marine Village Ballina Killaloe Co. Clare IRELAND	moiireland@yahoo.ie
Elena Ezhova	P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Atlantic Branch, Kaliningrad, RUSSIA	igelinez@gmail.com
Ester Cecere	Istituto per l'Ambiente Marino Costiero (IAMC) – CNR via Roma 3, 74123 Taranto, ITALY	ester.cecere@iamc.cnr.it
Erika Magaletti		erika.magaletti@isprambiente.it
Farrah Chan (Remote Participation)	Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, 867 Lakeshore Road, Burlington, ON, L7S 1A1, CANADA	farrah.chan@dfo-mpo.gc.ca
Francis Kerckhof	Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models (MUMM) 3de en 23ste Linieregimentsplein B-8400 Oostende, BELGIUM	fkerckhof@naturalsciences.be
Francesca Garaventa		francesca.garaventa@ismar.cnr.it
Ceccherelli Giulia	University of Sassari ITALY	cecche@uniss.it
Gordon H. Copp	Centre for Environment, Fisheries and Aquaculture Science Pakefield Road Lowestoft, NR33 0HT UNITED KINGDOM	gordon.copp@cefas.co.uk
Henn Ojaveer (chair)	Estonian Marine Institute University of Tartu 2a Lootsi EE-80012 Parnu, ESTONIA	henn.ojaveer@ut.ee
Jenni Kakkonen	Marine Services Orkney Islands Council Harbour Authority Building Scapa, Orkney, KW15 1SD UNITED KINGDOM	jenni.kakkonen@orkney.gov.uk

Johanna Bradie (Remote Participation)	Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, 867 Lakeshore Road, Burlington, ON, L7S 1A1, CANADA	johanna.bradie@dfo-mpo.gc.ca
John Darling	National Exposure Research Laboratory, United States Environmental Protection Agency, Durham, NC 27713, USA	darling.john@epa.gov
João Canning-Clode	MARE – Marine and Environmental Sciences Centre, Marine Biology Station of Funchal, Cais do Carvão 9000–107 Funchal / Madeira Island PORTUGAL	canning-clodej@si.edu
Judy Pederson	MIT Sea Grant College Program E38–300 Cambridge MA 02139 UNITED STATES	jpederso@mit.edu
Kathe Rose Jensen	Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen Ø, DENMARK	krjensen@snm.ku.dk
Katja Broeg (By Correspondence)	Bundesamt fuer Seeschifffahrt und Hydrographie (BSH), Federal Maritime and Hydrographic Agency, Bernhard-Nocht-Str. 78 20359 Hamburg, GERMANY	katja.broeg@bsh.de
Kimberly Howland	Fisheries and Oceans Canada, Freshwater Institute, 501 University Crescent, Winnipeg, MB, R3T 2N6, CANADA	kimberly.howland@dfo-mpo.gc.ca
Laura Airoldi	Università di Bologna, Dipartimento di Scienze Biologiche, Geologiche ed Ambientali BIGEA, sede di Ravenna Via S. Alberto 163, 48123, Ravenna ITALY	laura.airoldi@unibo.it
Lauri Urho	Natural Resources Institute FinlandP.O. Box 2, FI-00791 Helsinki FINLAND	lauri.urho@luke.fi
Lena Granhag (Remote Participation)	Chalmers University of Tehnology Shipping and marine technology 412 96 Gothenburg, SWEDEN	lena.granhag@chalmers.se
Lisa Drake	Naval Research Laboratory PO Box 1739 Key West FL 33041–1739 UNITED STATES	lisa.drake@nrl.navy.mil

Lyndsay Brown	Marine Scotland - Science Marine Laboratory, PO Box 101 375 Victoria Road, Aberdeen, AB11 9DB UNITED KINGDOM	lyndsay.brown@scotland.gsi.gov.uk
Maiju Lehtiniemi	Finnish Environment Institute (SYKE) P.O. Box 140 Mechelininkatu 34a 00251 Helsinki FINLAND	maiju.lehtiniemi@ymparisto.fi
Margaret (Peg) Brady (Remote Participation)	National Oceanic & Atmospheric Administration 1315 East West Highway, Silver Spring, MD, 20910 UNITED STATES	peg.brady@noaa.gov
Monika Normant-Saremba	Department of Experimental Ecology of Marine Organisms Institute of Oceanography University of Gdańsk Al. Marszalka Piłsudskiego 46 81–378 Gdynia, POLAND	monika.normant@ug.edu.pl
Nathalie Simard	Fisheries and Oceans Canada Maurice Lamontagne Institute 850 Route de la mer, P.O. Box 1000 Mont-Joli (Quebec), G5H 3Z4 CANADA	nathalie.simard@dfo-mpo.gc.ca
Paul Stebbing (by correspondence)	Centre for Environment, Fisheries and Aquaculture Science The Nothe, Barrack Road, Weymouth, Dorset, DT4 0AB UNITED KINGDOM	paul.stebbing@cefas.co.uk
Paula Chainho	MARE – Marine and Environmental Sciences Centre Faculdade de Ciencias da Universidade de Lisboa Campo Grande 1749–016 Lisbon PORTUGAL	pmchainho@fc.ul.pt
Phil Davison	Centre for Environment Fisheries and Aquaculture Science (Cefas) Pakefield Road Lowestoft, NR33 0HT UNITED KINGDOM	phil.davison@cefas.co.uk
Sarah Bailey	Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, 867 Lakeshore Road, Burlington, ON, L7S 1A1, CANADA	sarah.bailey@dfo-mpo.gc.ca
Sarah Caronni		sarah.caronni@unipv.it
Sergej Olenin	Marine Science and Technology Center Klaipeda University (KU-MARSTEC) H. Manto str. 84, Klaipeda, 92294 LITHUANIA	sergej.olenin@jmtc.ku.lt

Stephan Gollasch	GoConsult Grosse Brunnenstr. 61 22763 Hamburg, GERMANY	sgollasch@gmx.net
Thomas Landry	Fisheries and Oceans Canada Gulf Fisheries Centre P.O. Box 5030 Moncton, NB E1C 9B6, CANADA	thomas.landry@dfo-mpo.gc.ca
Thomas Therriault	Department of Fisheries and Oceans Canada, Pacific Biological Station, CANADA	thomas.therriault@dfo-mpo.gc.ca

Annex 2: Meeting agenda

	WEDNESDAY 16TH MARCH **JOINT MEETING WITH WGBOSV**	
08.30	Set Up Computers	.15
08.45	Welcoming remarks: **Sarah Bailey, Henn Ojaveer** (Co-Chairs), **Anna Occhipinti** (Host)	.10
	Introduction of Participants	.15
	Review joint WGBSOV/WGITMO Terms of Reference and Agenda	.10
09.30	**WGBSOV ToR e):** Investigate and evaluate methods/technologies to assess risks of, to minimize extent of, and to respond to vessel biofouling to inform national and/or international policies or guidelines / **WGITMO ToR d)** Continue investigating NIS associated with biofouling, incl. those on artificial hard structures in the marine environment and recreational boating. ***ToR Lead: Cynthia McKenzie***	
	Presentation: Canadian national risk assessment of biofouling by recreational boats – **Cynthia McKenzie**	.20
	Questions	.10
	Presentation: Challenges and opportunities of an ecologically-based design of marine infrastructures – **Laura Airoldi**	.20
	Questions	.10
10.30	**Morning break**	.30
11.00	**WGBOSV ToR f):** Evaluate the current role/importance of shipping in relation to other invasion vectors/pathways globally / **WGITMO ToR f):** Evaluate the role/importance of different bioinvasion vectors and pathways globally. ***ToR Leads: Sarah Bailey/Henn Ojaveer***	
	Short review of related activities – **Henn Ojaveer**	.10
	Short review of related activities – **Bella Galil**	.10
	Short review of related activities – **Tom Therriault**	.10
	Questions	.10
	Discussion, Gap Analysis and Strategic Planning under ToR f)	.45
12.30	**Lunch break**	.60
1.30	Location of next meeting and joint WGBOSV/WGITMO ToRs (2017–18)	.15
	Discussion of joint WGBOSV/WGITMO ToRs (2017–18)	.15
2.00	**New Item:** Develop ICES Demonstration Advice on Ballast Water in the Arctic. ***Lead: Andrea Sneekes***	
	Background About the Request to WGBOSV/WGITMO and ICES Advice – **Henn Ojaveer**	.10
	Presentation: DRAFT ICES Demonstration Advice on Ballast Water in the Arctic – **An-**	.20

	drea Sneekes	
	Questions	.10
	Group Discussion/Revision/Strategic Planning to develop Draft Advice Document	.30
15.00	**Afternoon break**	.30
15.30	**WGBOSV ToR d):** Investigate and evaluate climate change impacts on the establishment and spread of ship-mediated nonindigenous species, particularly with respect to the Arctic / **WGITMO ToR c):** Continue identification and evaluation of climate change impacts on the establishment and spread of NIS. Finalize global review on salinity change effects on non-indigenous species. ***ToR Lead: Nathalie Simard***	
	Presentation: Arctic Council Objectives related to introduced species – **Peg Brady** (*by videoconference*)	.20
	Questions	.10
	Discussion, Gap Analysis and Strategic Planning under ToR d)	.30
16.30	Discuss any Issues Outstanding or Any Other Business	.60
	THURSDAY 17TH MARCH	
08.30	Reconvene for day 2- set up computers	.30
09.00	Review of WGITMO Terms of Reference and Agenda	.20
09.20	ToR a): Summarize information provided in national reports and through the AquaNIS information system. Develop annual summaries of new occurrences/introductions of aquatic non-indigenous species (NIS). ***ToR Lead: Henn Ojaveer***	
	National reports /highlights copied from national reports/ • Belgium **Francis Kerckhof** • Canada **Cynthia McKenzie** • Denmark **Kathe Jensen** • Finland **Lauri Urho** • France **Amelia Curd** • Germany **Stephan Gollasch** • Ireland **Dan Minchin**	
10.30	Morning break	.15
10.50	Review of national activities continues	
	• Israel **Bella Galil** • Italy **Anna Occhipinti** • Lithuania **Sergej Olenin** • Norway **Anders Jelmert** • Poland **Monika Normant-Saremba** • Portugal **Paula Chainho** • Russia **Elena Ezhova**	

12.30	Lunch break	.75
13.45	ToR a) continues • UK **Lyndsay Brown** • USA **Judy Pederson** • Estonia **Henn Ojaveer**	
	Presentation: Review of taxonomic tools for NIS – **Thomas Landry** Discussion	.30
	Presentation: AquaNIS status update and annual new NIS reporting – **Sergej Olenin** Discussion	.20
14.20	ToR b): Continue addressing EU MSFD D2 on further developing and evaluating NIS indicators and screening and identification of species of concern. ***ToR Leads: Sergej Olenin and Henn Ojaveer***	
	Presentation: Indicator on the number of new NIS – **Sergej Olenin** Discussion	.20
15.00	Afternoon break	.15
	Presentation: A cross-regional comparison of non-indigenous species indicators: problems and opportunities for a common assessment – **Paula Chainho** Discussion	.20
16.20	ToR c) continues: ***ToR Lead: Nathalie Simard***	
	Presentation: Global review on salinity change effects on non-indigenous species – **Joao Canning-Clode**	.30
	Presentation: Impacts of climate change on NIS in the Baltic – **Maiju Lehtiniemi**	.20
17.25	Election of the chair	.05
17.30	**Close of Day 2**	
	FRIDAY 18TH MARCH	
08.30	Reconvene for day 3 – set up computers	.10
08.40	Inspiring presentation(s) by the host country representative(s) – **Anna Occhipinti** *et al.*	.60
09.40	ToR e): Finalise draft of the alien species alert report for ICES CRR on Didemnum vexillum ***ToR Lead: Cynthia McKenzie***	
	Brief information: 9th International Conference on Marine Bioinvasions – Judy Pederson	.15
10.30	Morning break	.15

10.45	Marine alien species in the Greater North Sea area – **Kathe Jensen** Discussion	.30
	Developing molecular tools for early detection of aquatic invaders introduced via ballast water – **Anais Rey**	.15
11.30	ToR b) continues:	
	Trial assessments using the Aquatic Species Invasiveness Screening Kit (AS-ISK) for several risk assessment areas and taxa – **Gordon H. Copp**	.30
	Lunch break	.80
13.20	Assessing biological invasions in European Seas: Biological traits of the most widespread non-indigenous species – **Alice Cardeccia**	.25
13.45	Rapid assessment of target species: cost effective field sampling – **Dan Minchin**	.20
14.05	• ICES-PICES-CIESM cooperation • ICES request on NIS info (follow-up from ecosystem overviews) • New NIS for the ICES CRR species alert report • Reporting requirements • National reporting format (incl. data submission to AquaNIS) • Timing of the meeting • AOB	
15.00	**End of the meeting**	

Annex 3: National reports

Belgium

Prepared by Francis Kerckhof

Highlights

During 2015 a second small population of the Manilla clam *Ruditapes philippinarum* was discovered in Oostende.

In October 2015 the read alga *Dasysiphonia japonica* has been found in situ on a pontoon in the Marina of Zeebrugge.

1. Laws and regulations

There is no new national legislation to report. The various EU legislations are being implemented.

2. Intentional introductions

There is no information available on intentional introductions if any.

3. Unintentional introductions

During 2015 a second population of the Manilla clam *Ruditapes philippinarum* was discovered (Kerckhof, 2016). The small population lives on the so called Klein Strand in Oostende, an artificially created beach - embayment. Co-occurring species included *Cerastoderma edule, Ensis directus, Venerupis corrugata, Mya arenaria, Spisula subtruncata* and *Macoma balthica*. Such an intertidal assemblage of species is not known elsewhere along the Belgian coast and is because of the particular sheltered condition of this small beach with a sediment of rather coarse sand with mud.

In October 2015 the read alga *Dasysiphonia japonica* has been discovered in situ for the first time in Belgian waters on the pontoons of the marina of Zeebrugge together with amongst others *Aglaothamnion hookeri, Neosiphonia harveyi, Pterothamnion plumula, Antithamnionella spirographidis & Undaria pinnatifida*. Earlier, in December 2014, the species was found on the hull of the RV Belgica which often moored at the port of Zeebrugge.

All introduced species that were reported during previous years are still present and seem to be well-established and thriving except for the barnacle *Megabalanus coccopoma* of which there are no recent records anymore.

4. Pathogens

No information

5. Meetings

6. Research projects

The Phycology research group of the Ghent University is partner in the INVASIVES project that aims to assess present and future impacts of invasive alien seaweeds on the North-Atlantic coastal biodiversity, by using a combination of modelling, field studies, ecological experiments, biochemical and molecular work. The project aims specifically at predicting the effects of alien seaweeds under climate variability and rising sea surface temperatures in the North-Atlantic.

In the framework of the Invasives project the risk of aquarium trade toward introductions of seaweed in European waters was investigated (Vranken *et al.* 2016). A large-scale survey of marine seaweeds diversity found in the European aquarium trade circuit was undertaken, in order to assess the risk of introducing potentially invasive species by aquarium trade in the North-Atlantic. The main objective was to characterize the risk posed by the European aquarium trade market regarding introduction of potentially invasive species and their possible impact on the European biodiversity. The diversity and magnitude of the European aquarium trade circuit was characterized. Secondly, the algae diversity encountered in aquaria ranging from private aquarists over shops and wholesalers to public aquaria was sampled. Using DNA-barcoding approaches no less than 137 species were identified, of which 15% are flagged as introduced species. Subsequently the realized temperature niche was estimated, using species occurrence data available from OBIS and GBIF in an attempt to predict the potential range of these species in Europe by mapping the realized temperature niche on present and future climate conditions. These data are used to identify regions particularly vulnerable toward introductions of aquarium-associated seaweeds.

7. References and bibliography

Kerckhof F. (2016). Nieuwe natuur: de bivalven fauna van het Klein Strand in Oostende en een tweede populatie van de Filipijnse tapijtschelp *Ruditapes philippinarum.* De Strandvlo 36(21): 6–17.

Vranken S., Bosch S., Peña V.P., Leliaert F., Mineur F. & De Clerck O. (2016). The risk of aquarium trade toward introductions of seaweed in European waters, in: Mees J. *et al.* (Ed.) (2016). Book of abstracts – VLIZ Marine Scientist Day. Brugge, Belgium, 12 February 2016. VLIZ Special Publication, 75: pp. 137

Canada

Prepared by Cynthia McKenzie

Overview

Fisheries and Oceans Canada has finalized the new Aquatic Invasive Species Regulations for the *Fisheries Act* and it is now in force in Canada effective 17 June 2015. (http://gazette.gc.ca/rp-pr/p2/2015/2015–06–17/html/sor-dors121-eng.php)

A National Recreational Boating AIS Vector Risk Assessment was conducted in 2015. (see presentation ToR d). *Didemnum vexillum*, confirmed for the first time in 2013 in Atlantic Canada in Minas Basin, in the upper Bay of Fundy, was reported at additional sites in 2015. Other species that have already invaded Canadian waters continue to spread, including European green crab (*Carcinus maenas*), vase tunicate (*Ciona intestinalis*), oyster thief (*Codium fragile*), golden star tunicate (*Botryllus schlosseri*), clubbed tunicate (*Styela clava*), European sea squirt (*Ascidiella aspersa*) and violet tunicate (*Botrylloides violaceus*).

1. Regulations

Fisheries and Oceans Canada has developed regulations to manage the threat of aquatic invasive species (AIS). The Aquatic Invasive Species Regulations was published in the *Canada Gazette,* Part II, on 17 June 2015.

The regulations include:

1. **List of Prohibited Species** (Part 2 currently freshwater species e.g. Asian carp, zebra mussels)
2. **List of Controlled Species** The regulation also includes a list of 14 species (Part 3 of the Schedule) that are NOT prohibited but for which control activities may be undertaken where they are not indigenous and may cause harm
3. List includes tunicates, green crab, and species such as smallmouth bass and walleye which are native to some parts of Canada but are considered invasive elsewhere
4. Species listed are the ones for which DFO has completed risk assessments and the outcome was moderate to high risk

Part 3. This table shows the species subject to controls only in areas where they are not indigenous.

Item	Column 1 Common Name	Column 2 Scientific Name
1.	Club tunicate	*Styela clava*
2.	**Vase tunicate**	*Ciona intestinalis*
3.	**Golden Star tunicate**	*Botryllus schlosseri*
4.	**Violet tunicate**	*Botrylloides violaceus*
5.	Didemnum	*Didemnum vexillum*
6.	Bloody red shrimp	*Hemimysis anomala*
7.	**European green crab**	*Carcinus maenas*

8.	Chinese mitten crab	*Eriocheir sinensis*
9.	Smallmouth bass	*Micropterus dolomieu*
10.	Largemouth bass	*Micropterus salmoides*
11.	Northern pike	*Esox lucius*
12.	Pumpkinseed	*Lepomis gibbosus*
13.	Walleye	*Sander vitreus*
14.	Yellow perch	*Perca flavescens*

The regulation allows prescribed Ministers to authorize the deposit of deleterious substances to control or eradicate AIS: 1) Conditions such as not compromising public safety and taking into account impact and alternative measures have to be followed. 2) Only approved drug and pest control products can be used. 3) Control and eradication activities may be ***authorized*** for species listed in the regulation (Part 2 and 3 of the Schedule), as well as any aquatic species where it is not indigenous and may cause harm.

2. Intentional Introductions:

Prior to 31 December 2015, Fisheries and Oceans Canada, along with the provinces and territories, managed disease, genetic, and ecological risks associated with aquatic animal movements through a variety of federal, provincial, and territorial regulations under the National Code on Introductions and Transfers of Aquatic Organisms. However, disease risk is now managed by the Canadian Food Inspection Agency (CFIA) through the National Aquatic Animal Health Program under the Health of Animals Regulations..

For details on the intentional introductions by province for 2015, see

http://www.dfo-mpo.gc.ca/aquaculture/management-gestion/intro-eng.htm.

3. Unintentional Introductions:

New Sightings-

There were no new sightings of marine AIS reported in 2015.

Spread of established AIS species

Didemnum vexillum, confirmed for the first time in 2013 in Atlantic Canada in Minas Basin, in the upper Bay of Fundy, was reported at additional sites in 2014 and 2015.

Range expansion has been identified for *Carcinus maenas*, *Ciona intestinalis*, *Botryllus schlosseri*, *Styela clava*, *Botrylloides violaceus*, *Membranipora membranacea* and *Codium fragile*.

Some specific examples include:

Carcinus maenas continues to spread into north-eastern New Brunswick, Prince Edward Island and Nova Scotia. Green crab continues to spread in Newfoundland in Placentia

Bay and along the western coast of the province and was found in Fortune Bay on the south coast Captures of green crab in Magdalen Islands, Quebec have decreased during the last three years. Cold winters or control efforts are potential factors that could explained this important drop. Green crab continue to spread in Placentia Bay, NL and have expanded into Fortune Bay, NL.

Ciona intestinalis is now established on the eastern shore of Nova Scotia, in Chedabucto Bay, Cape Breton, along the south and southwest shores of mainland Nova Scotia and in SW New Brunswick and is found in isolated areas of the Burin Peninsula in Newfoundland and Labrador.

Botryllus schlosseri is now present in most Bays and harbors along the south, and south west coast of mainland Nova Scotia, as well as in coastal Cape Breton and the Bras D'Or lakes and Magdalen Islands. It is well established in SW New Brunswick and continues to spread into the NE of the province. Golden Star Tunicate was detected for the first time on Gaspesie, Quebec on collector plates in 2012 but was never observed in that area since that time. Scallop and mussels farmers on the Magdalen Islands have found high densities of golden star tunicate on their structures in 2014 and 2015, a situation which is becoming a concern for that industry.

Botrylloides violaceus continued to spread to new locations in Nova Scotia. It is not yet widespread in SW New Brunswick, however it continues to spread in NE New Brunswick and Magdalen Islands.

Styela clava was reported in Nova Scotia for the first time in 2012. This species is now present in Chedabucto Bay on the East coast of the province between the mainland and Cape Breton.

Membranipora membranacea is well established on the Atlantic coast of Canada since 1990s. In 2014, high densities of brown macroalgae (Laminaria type) heavily covered with *Membranipora membranacea* were reported to be present on beaches all around Gaspe Peninsula. A rapid assessment was conducted in 2015 in this region.

4. Pathogens

None reported.

5. Meetings

Atlantic Zonal AIS Monitoring meeting, Moncton New Brunswick, February 2015.

Canadian Aquatic Invasive Species Network II Annual General Meeting. Halifax, Nova Scotia, Canada. May 2015.

Canadian Science Advisory Sector Meetings

DFO. 2015. Marine Screening-Level Risk Assessment Protocol for Aquatic Non-Indigenous Species. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/nnn.

DFO. 2015 National Recreational Boating Risk Assessment Advisory meeting, Montreal, Quebec, December 2015.

Future meetings

19th International Conference on Aquatic Invasive Species (ICAIS), Winnipeg, Canada, 10–14 April 2016

International Conference on Marine Bioinvasions X, 16–18 October 2018 in Argentina.

5. References and bibliography

Carman M.R., Colarusso P.D., Nelson E.P., Grunden D.W., Wong M.C., McKenzie C., Matheson K., Davidson J., Fox S., Neckles H., Bayley H., Schott S., Dijkstra J.A. & Stewart-Clark S. (2016) Distribution and diversity of tunicates utilizing eelgrass as substrate in the western North Atlantic between 39° and 47° north latitude (New Jersey to Newfoundland). Management of Biological Invasions, 7: 51–57.

Chan F.T., MacIsaac H.J. & Bailey S.A. 2015. Relative importance of vessel hull fouling and ballast water as transport vectors of nonindigenous species to the Canadian Arctic. Canadian Journal of Fisheries and Aquatic Sciences, 72: 1230–1242.

DFO. 2015. Risk assessment of alternate ballast water exchange zones for vessel traffic to the eastern Canadian Arctic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/019.

DFO. 2015. Proceedings of the regional peer review of the risk assessment of Alternate Ballast Water Exchange Zones for vessel traffic to the eastern Canadian Arctic; 20–21 November 2013. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2015/009.

Drolet D., DiBacco C., Locke A., McKenzie C.H., McKindsey C.W., Moore A.M., Webb J.L. & Therriault T.W. 2015 Evaluation of a new screening-level risk assessment tool applied to non-indigenous marine invertebrates in Canadian coastal waters. Biological Invasions. DOI 10.1007/s10530–015–1008-y

Lowen J.B., Deibel D., McKenzie C., Couturier C. & DiBacco C. 2015. Tolerance of early life-stages in Ciona intestinalis to bubble streams and suspended particles. Management of Biological Invasions (early view).

McKenzie C.H, Matheson K., Caines S. & Wells T. Surveys for non-indigenous tunicate species in Newfoundland, Canada (2006–2014): A first step towards understanding impact and control. 2016 Management of Biological Invasions, 7: 21–32.

McKenzie C.H., Matheson K., Reid V., Wells T., Mouland D., Green D., Pilgrim B. & Perry G. 2016. The development of a rapid response plan to control the spread of the solitary invasive tunicate, Ciona intestinalis, (Linneaus 1767), in Newfoundland and Labrador, Canada. Management of Biological Invasions. 7: 87–100

Reid V., McKenzie C.H., Matheson K., Wells T. & Couturier C. 2016. Post-metamorphic attachment by solitary ascidian *Ciona intestinalis* (Linnaeus, 1767) juveniles from Newfoundland and Labrador, Canada. Management of Biological Invasions, 7: 67–76.

Scriven D.R., DiBacco C., Locke A & Therriault T.W. 2015. Ballast water management in Canada: A historical perspective and implications for the future. Marine Policy, 59: 121–133.

Vercaemer B., Sephton D., Clement P., Harman A., Stewart-Clark S.& DiBacco C. 2015. Distribution of the non-indigenous colonial ascidian *Didemnum vexillum* (Kott, 2002) in the Bay of Fundy and on offshore banks, eastern Canada. Management of Biological Invasions, 6: 385–394.

Denmark

Prepared by Kathe R. Jensen, with inputs from O.S. Tendal, H.U. Riisgård, L.S. Olsen, P. Dolmer, K. Weile, C.B. Thøstesen and J. Behrens.

Highlights

A report on pathway analysis and "horizon scanning" has been published by NOBANIS. Several meetings have been held related to the EU-list, implementation of MSFD D2, management of Pacific oyster and round goby. *Bonamia ostreae* was recorded for the first time (since monitoring began in 2000) in *Ostrea edulis* in the Limfjord.

Regulations

EU Parliament and Council Regulation 1143/2014 of 22 October 2014 took force on 1 January 2015, and the Danish version has been sent out for public hearing in November – December 2015. This included only the list of species of EU concern, not national or regional lists. There have been meetings at the Nature Agency concerning this issue (see below), and a national regulation is expected within a few months from submitting this report.

The report produced by NOBANIS on pathway analysis and "horizon scanning" has been published by the Nordic Council of Ministers.

An EU report on "horizon scanning" for potential invasive alien species has also been published in 2015 (Roy *et al.*, 2015).

The Nature Agency published a report on the monitoring program for the Marine Strategy Framework Directive (MSFD). For this (and other marine monitoring) Danish waters have been subdivided into 3 subregions: 1) North Sea and Skagerrak; 2) Kattegat and northern Sound (Øresund); 3) Belt Sea and Baltic Sea (Naturstyrelsen, 2014). Monitoring for D2, non-indigenous species, is described in very broad terms (pp. 27–29 in report), and it seems likely that new introductions may be overlooked. Citizen science ("key fishermen") and user-paid surveys (in connection with the Ballast Water Management Convention) are major ingredients.

The Consolidation Act of the Marine Strategy of Denmark (LBK nr. 1582 af 10/12/2015) became effective on 10 December 2015 (available at https://www.retsinformation.dk/forms/r0710aspx?id=175602).

Import and Export (source: Statistikbanken at http://www.statistikbanken.dk/)

In 2015, Denmark imported about 32 tons of saltwater aquarium fish, 14 tons alone from Indonesia and 10 tons from the Netherlands. Minor imports came from the Philippines, Sri Lanka, USA, and other countries.

Denmark imported a total of 67.5 tons of live lobster, *Homarus* spp., 49 of which came from Canada, 6.5 from the USA and 10 from Great Britain.

Only minor amounts of live saltwater fish and shellfish were imported to Denmark in 2015.

Exports of live fish were mostly freshwater species from aquaculture, and mostly to EU countries (Germany, Austria, Finland). Live oysters were exported mainly to France, Spain and the Netherlands. Live blue mussels were mainly exported to the Netherlands, Germany, Sweden and Ireland.

Fisheries statistics (2014) are available at http://webfd.fd.dk).

Unintentional introductions:

Macrophytes

An international review of the global invasion of *Sargassum muticum*, including Danish participation, has been published (Engelen *et al.*, 2015).

An MSc thesis has been carried out on *Spartina anglica* on the island Læsø in northern Kattegat (Rudolph, 2015).

Invertebrates

Several publications have been published on various aspects of the biology and ecology of *Mnemiopsis leidyi* (Colin *et al.*, 2015; Jaspers *et al.*, 2015a,b; Riisgård *et al.*, 2015). The Zoological Museum in Copenhagen has received information from citizens on occurrence of *M. leidyi* in Danish waters (O.S. Tendal, pers. comm.)

The Chinese mitten crab, *Eriocheir sinensis*, has been recorded from the Limfjord, west of the city Aalborg, in the spring of 2015 (2 specimens) and in Karrebæk Fjord (Great Belt) in November 2015. Fishermen have now been told to kill them when they catch them, so they usually only get reported when the specimens are very big. This means the recorded specimens are usually large males. So far there have been no indications that the species is reproducing in Danish waters.

Rhithropanopeus harrisii is becoming more abundant in the Danish part of the Baltic Sea and the southern part of the Sound. It is considered a nuisance by local fishermen. A student project on population genetics is in progress.

The two species of *Hemigrapsus, H. takanoi* and *H. sanguineus* have both been confirmed from several localities in the Danish part of the Wadden Sea (K. Weile and C.B. Thøstesen, pers. comm.).

Two large specimens of *Crassostrea gigas* from the Isefjord were brought to the public aquarium in Copenhagen (Den Blå Planet), where they have been kept alive for several months (L.S. Olsen, pers. comm.). A study of oyster populations in the Limfjord estimated the population of *C. gigas* to be about 25 tons in the western Limfjord (Nissum Bredning, Kaas Bredning and Harre Vig), and the authors expressed concern that, due to lack of recruitment of *O. edulis*, *C. gigas* may be overtaking some of the area previously used by *O. edulis* (Fomsgaard & Petersen, 2015). This may be further enhanced by the recent occurrence of *Bonamia ostreae* (see below). Another study from the Limfjord concluded that recruitment of *C. gigas* is generally low, and that the species is still in the "establishment phase" (Holm *et al.*, 2015). The final report of a Scandinavian project on Pacific oysters as case study for monitoring and management of invasive species has been published (Dolmer *et al.*, 2015).

The ICES Species Alert report for the American jackknife clam, *Ensis directus*, was published in February 2015 (Gollasch *et al.*, 2015).

Ocenebra inornata is still present in the western Limfjord, and may also cause reduction in recruitment of oysters, both native and invasive, by drilling young (thin-shelled) specimens (Fomsgaard & Petersen, 2015).

Fish

Round goby, *Neogobius melanostomus*, is continuing to spread in Danish waters at a rate of 30 km per year, and also population density is increasing (Azour *et al.*, 2015; Behrens, 2015), and an international collaboration on management is in progress (Ojaveer *et al.*, 2015). The species is now dominant in certain parts of the Danish part of the Baltic Sea, and, according to local fishermen, threatens shrimp fishery. This has caught the attention of the press (e.g. http://videnskab.dk/miljo-naturvidenskab/sortmundet-kutling-spreder-sig-hastigt-i-danmark-og-truer-din-rejemad). A new project has been initiated to study the tolerance of higher salinities in order to assess to risk of the the species spreading to Kattegat, the Limfjord and the North Sea. Preliminary results show that it is fully tolerant of salinities up to 20 ppt, and that some individuals can tolerate up to 30 ppt (see http://www.aqua.dtu.dk/Nyheder/2015/07/Kutling-ices?id=19993305–23e0–4a9e-b706–906708ef1bc2, http://www.fiskepleje.dk/Nyheder/2015/12/Sortmundet-kutlings-salttolerance?id=4d66f5b2–7920–4f99–8d8b-4e83057be887, and Behrens *et al.*, 2015).

Microorganisms

The oyster parasite *Bonamia ostreae* was detected for the first time in European flat oysters, *Ostrea edulis*, in the Limfjord. Oysters had been collected in November 2014, but analyses had not been verified till March 2015. This means that the Limfjord can no longer be declared *Bonamia*-free, which it has been since 2004, meaning that *Bonamia* has been absent at least since 2000 (Madsen, 2015). Apparently mortality of infected oysters was very low, but it is unknown whether this is because the oysters are resistant or the parasite is less virulent.

Meetings:

27 February 2015, Meeting on management and monitoring of invasive species in Nordic countries, with special focus on the Pacific Oyster, *Crassostrea gigas*, ten invited participants from Nordic countries, held at NaturErhvervsstyrelsen, Copenhagen, Denmark.

31 August 2015, Seminar at "Den Blå Planet" (Public Aquarium) on Round goby; new invasive species threatening Denmark. Speakers J. Behrens and E. Flindt, both from DTU Aqua.

18 September 2015, MONIS 2-workshop on a Danish MSFD NIS Target Species List. 16 invited participants, held at NIVA Denmark, Copenhagen, Denmark

29 September 2015, Meeting of advisory group on invasive species, held at the Nature Agency, Copenhagen, Denmark.

26 October 2015, Workshop on invasive species in relation to EU directive, held at COWI, Lyngby, Denmark.

References

Azour, F., Van Deurs, M., Behrens, J., Carl, H., Hüssy, K., Greisen, K., Ebert, R. & Møller, P.R. 2015. Invasion rate and population characteristics of the round goby *Neogobius melanostomus*: effects of density and invasion history. Aquatic Biology 24(1): 41–52.

Behrens, J. 2015. Kan den invasive sortmundede kutling sprede sig til Skagerrak og Nordsøen? (Article available at http://www.fiskepleje.dk/Nyheder/2015/12/Sortmundet-kutlings-salttolerance?id=4d66f5b2–7920–4f99–8d8b-4e83057be887).

Behrens, J.W., Van Deurs, M. & Christensen, E.A.F. 2015. Salinity tolerance and correlated physiology of the invasive round goby *Neogobius melanostomus*). ICES CM 2015/Q:27, 2pp. (available at http://www.ices.dk/sites/pub/ASCExtendedAbstracts/SitePages/Home.aspx).

Colin, S.P., MacPherson, R., Gemmell, B., Costello, J.H., Sutherland, K. & Jaspers, C. 2015. Elevating the predatory effect: Sensory-scanning foraging strategy by the lobate ctenophore *Mnemiopsis leidyi*. Limnology and Oceanography 60: 100–109.

Dolmer, P., Strand, Å., Bodvin, T. & Mortensen, S. (Eds.) 2015. Development of programs for monitoring and management of invasive species in Nordic waters. Pacific oysters as a case study and review of international and EU regulation of invasive species. Final report from ORBICON (DK), University of Gothenburg (SE) and Haforskningsinstituttet (NO), 137pp.

Engelen, A.H., Serebryakova, A., Ang, P., Britton-Simmons, K., Mineur, F., Pedersen, M.F., Arenas, F., Fernandez, C., Steen, H., Svenson, R., Oavia, H., Toth, G., Viard, F. & Santos, R. 2015. Circumglobal invasion by the brown seaweed *Sargassum muticum*. Oceanography and Marine Biology: An Annual Review 53: 81–126.

Fomsgaard, C. & Petersen, J.K. 2015. Pleje af østersbestanden I Limfjorden. DTU Aqua report no. 291–2015, 32pp.

Holm, M.W., Davids, J.K., Dolmer, P., Vismann, B. & Hansen, B.W. 2015. Moderate establishment success of Pacific oyster, *Crassostrea gigas*, on a sheltered intertidal mussel bed. Journal of Sea Research 104: 1–8.

Jaspers, C., Acuña, J.L. and Brodeur, R.D. 2015. Introduction. Interactions of gelatinous zooplankton within marine food webs. Contribution to the ICES/PICES Theme Session: “Interactions of Gelatinous Zooplankton within Marine Food Webs”. Journal of Plankton Research 37(5): 985–988.

Jaspers, C., Møller, L.F. and Kiørboe, T. 2015. Reproduction rates under variable food conditions and starvation in *Mnemiopsis leidyi*: significance for the invasion success of a ctenophore. Contribution to the ICES/PICES Theme Session: ‘Interactions of Gelatinous Zooplankton within Marine Food Webs’. Journal of Plankton Research 37(5): 1011–1018.

Madsen, L. 2015. Fund af *Bonamia ostreae* I danske østers fra Limfjorden. DVT 8: 2015 (available at http://infolink2003.elbo.dk/DVT/dokumenter/doc/15764.pdf).

Naturstyrelsen (Nature Agency) 2015. Danmarks Havstrategi. Overvågningsprogram [Marine Strategy of Denmark. Monitoring programme]. Report from the Ministry of Environment, Danish Nature Agency, 53pp (available at: http://naturstyrelsen.dk/media/nst/12323931/samlet_overv_gningsprogram_for_hsd.pdf).

NOBANIS 2015. Invasive alien species. Pathway analysis and horizon scanning for countries in northern Europe. TemaNord 2015: 517, 232 pp (http://dx.doi.org/10.6027/TN2015–517).

Ojaveer, H., Galil, B.S., Lehtiniemi, M., Christoffersen, M., Clink, S., Florin, A.-B., Gruszka, P., Puntila, R. and Behrens, J.W. 2015. Twenty five years of invasion: management of the round goby *Neogobius melanostomus* in the Baltic Sea. Management of Biological Invasions 6(4): 329–339.

Riisgård, H.U., Goldstein, J., Lundgreen, K. and Lüskow, F. 2015. Jellyfish and ctenophores in the environmentally degraded Limfjorden (Denmark) during 2014 – species composition, population densities and predation impact. Fisheries and Aquaculture Journal 6:3 (http://dx.doi.org/10.4172/2150–3508.1000137)

Roy, H.E., Adriaens, T., Aldridge, D.C., Bacher, S., Bishop, J.D.D., Blackburn, T.M., Branquart, E., Brodie, J., Carboneras, C., Cook, E.J., Copp, G.H., Dean, H.J., Eilenberg, J., Essl, F., Gallardo, B., Garcia, M., Garcia-Berthou, E., Genovesi, P., Hulme, P.E., Kenis, M., Kerckhof, F., Kettunen, M., Minchin, D., Nentwig, W., Nieto, A., Pergl, J., Pescott, O., Peyton, J., Preda, C., Rabitsch, W., Roques, A., Rorke, S., Scalera, R., Schindler, S., Schönrogge, K., Sewell, J., Solarz, W., Stewart, A., Tricarico, E., Vanderhoeven, S., van der Velde, G., Vilà, M., Wood, C.A., Zenetos, A. 2015. Invasive alien species – Prioritizing prevention efforts through horizon scanning. ENV.B.2/ETU/2014/0016. European Commission.

Theses:

Rudolph, N. 2015. Managing and controlling invasive species: the case of *Spartina anglica* at Læsø, Denmark. MSc. Thesis, Leuphana University, Lüneburg, Germany (co-supervisor: R.M. Buttenschøn, University of Copenhagen, Denmark), 27 pp. (available at: http://naturstyrelsen.dk/media/138003/master-thesis_nadine-rudolph-2.pdf).

Estonia

Prepared by Henn Ojaveer, with contributions from Jonne Kotta

Overview

Shells of a new species for the country, the clam *Rangia cuneata* were found on the beach of the NE Gulf of Riga (Pärnu Bay). National non-indigenous species monitoring was continued in the scope and aims as in previous years. One of the aims is to monitor non-indigenous species in the high-risk areas of new invasions. Based on surveys in vicinity of the largest port in the country – Muuga harbor – no new non-indigenous species were identified in 2015. The cryptogenic cirriped *Amphibalanus improvisus* and the non-indigenous polychaete *Marenzelleria neglecta* appear to form very abundant populations. The round goby *Neogobius melanostomus* still colonises new areas and increases in abundance. However, its catches in gillnets in Muuga Bay (Gulf of Finland) have stabilized after five years of invasion (since 2010) and remained high. The Chinese mitten crab *Eriocheir sinensis* was not found in the long-term monitoring station in Muuga Bay. New evidences on the ecology and impacts of the predatory cladoceran *Cercopagis pengoi*, Harris mud crab *Rhithropanopeus harrisii*, the gammarid amphipod *Gammarus tigrinus* and the round goby were obtained. One specimen of the bighead carp *Aristichthys nobilis* was found in Pärnu Bay (NE Gulf of Riga).

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

The IMO BWMC ratification process is not yet finalized.

3. Unintentional introductions

Shells of the clam *Rangia cuneata* were found in early sprint in the NE Gulf of Riga (Pärnu Bay beach). This is the first observation of the species in Estonia. The first observation *R. cuneata* in the Baltic Sea dates back to 2010 (Kaliningrad region, Russia) and the species has also been observed in Poland and Lithuania (AquaNIS, 2016). Despite of extensive sampling programme at different habitats and depth range no living specimen was found in Pärnu Bay.

One specimen of the bighead carp *Aristichthys nobilis* (weight ≈ 9 kg, TL = 91.5 cm) was found in Pärnu Bay (NE Gulf of Riga), probably as escapee from Latvian fish farm. Previous findings of the species in the Gulf of Riga originate from the mouth of River Daugava in 1990 and 1992 (Plikshs & Aleksejevs, 1998) and from Pärnu Bay in 2000 and 2005.

An as-yet-undescribed, non-indigenous, polychaete species was found at very high densities in the north-eastern Gulf of Riga, Pärnu Bay in 2012. The species belongs to the sabellid genus *Laonome* Malmgren, 1866, but it could not be assigned to any of the previously described species. To date, the species has established a stable population after surviving a notably cold winter (2012/2013). The abundance of *Laonome* sp. exhibits strong seasonal variation, peaking between July and November. Besides seasonality, the quantity of decomposed microalgae in the sediment and wave exposure best explained the variation in abundance. This non-indigenous polychaete may potentially modify sediment morphology and chemistry and disrupt the natural infaunal communities. *Laonome* sp. could displace or even completely eliminate some species currently present in the study area and beyond if it spreads; however, it could also facilitate currently-present species through the provision of alternative substrate and/or food (Kotta *et al.* 2015).

In 2015, non-indigenous species monitoring was continued in the scope and aims as in previous years, with addition of port biological sampling according to HELCOM methodology. One of the aims is to monitor non-indigenous species in the high-risk areas of new invasions. Based on surveys both at and in vicinity of the largest port in the country – Muuga harbor (Port of Tallinn) – no new non-indigenous species were identified in 2015. The samples taken both from the harbour area as well as adjacent localities confirm that spatio-temporally, the most stable and abundant populations were those of the cirriped *Amphibalanus improvisus* and the polychaete *Marenzelleria neglecta*, however, with substantial reduction in distribution area and abundance of the latter species during a few recent years (Anon. 2016).

Another major aim of the non-indigenous species monitoring programme is to track the long-term performance of the already existing non-indigenous species in Estonian coastal sea (please also see Figures 1–5 at the end of the report). Time-series are available for the following planktonic taxa: *Cercopagis pengoi*, *Amphibalanus improvisus* larvae and *Marenzelleria neglecta* larvae. In 2015, very high abundances of *A. improvisus* and very low abundances of *C. pengoi* were recorded, while that of *M. neglecta* didn't exhibit any consistent pattern by two regions assessed (Figure 1). Our long-term data series analysis indicate that the late summer dynamics of the calanoid copepod *E. affinis* were explainable by a combination of positive SST effect and negative effect of *C. pengoi*. While these effects were for the younger stages independent of each other, we found for *E. affinis* adults indications of a control change. The TGAM suggested that SST has a positive effect only under low levels of *C. pengoi* abundances. At higher abundances of *C. pengoi*, reproductive processes governed by SST cannot counteract the predation pressure on *E. affinis*. In an average year, abundances of *C. pengoi* are above the threshold for entire July and August (data not shown). In contrast, abundances of *Acartia* spp. were not related to SST or abundances of *C. pengoi*, at least statistically (Klais *et al.* in prep.).

The benthic crustaceans *Chelicorophium curvispinum* and *Pontogammarus robustoides* are common at the SE coast of the Gulf of Finland (from Sillamäe to Narva-Jõesuu) and dominate in the benthic invertebrate communities at shallow depths. In 2015, the species was not found in the south-western part of the Gulf of Finland.

The bloody-red shrimp *Hemimysis anomala* has been increasingly found in the Estonian coastal sea. Although its densities are very low, a number of new localities have been observed in recent years: Pärnu Bay (Gulf of Riga) in 2009, 2012 and 2013; Muuga Bay (Gulf of Finland) in 2012 and Tallinn Bay (Gulf of Finland) in 2013. In 2015 no *H. anomala* were recorded in benthic samples. However, it is important to note that this species occurs only sporadically in the traditional monitoring samples due to its very specific habitat range.

Based on the most recent evidence, the grass prawn *Palaemon elegans* has colonized the whole Estonian coastal sea by having been found in multiple localities in the Gulf of Finland, West-Estonian Archipelago Sea, NE Baltic Proper and the Gulf of Riga. In 2015 the species still dominates among palaemonids in all these basins.

The range and density of the non-indigenous *G. tigrinus* is still increasing. Within a ten year of establishment the abundance of G. tigrinus showed no signs of decline with the invasive species exceeding about fifteen times the abundance values of native gammarids (Reisalu *et al.* 2016). Recent study has shown that the invasive *Gammarus tigrinus* has notably narrower and more segregated realized niche compared to the native gammarids. Among native species, the distribution of *G. zaddachi* overlapped the most with *G. tigrinus*. Our results confirm that widespread colonization does not require a wide niche of the colonizer, but may rather be a function of other biological traits and/or the saturation of the recipient ecosystem. The niche divergence and wider environmental niche space of native species are likely to safeguard their existence in habitats less suitable for *G. tigrinus* (Herkül *et al.* 2016). Specifically, in their suboptimal habitats the abundance of *G. tigrinus* was moderate allowing the coexistence of native gammarids and the invasive gammarid (Reisalu *et al.* 2016). Another recent experimental study demonstrated that the invasive *G. tigrinus* has higher reproductive potential compared to the native species (*Gammarus duebeni*, *Gammarus occanicus*, *Gammarus zaddachi*). Moreover, virtually all adult gammarids exerted a significant predation pressure on juvenile amphipods. Thus, the combined effect of predation on juvenile amphipods and large brood production of *G. tigrinus* could be plausible explanations describing increased abundance of *G. tigrinus* and decrease of local gammarid populations in the north-eastern Baltic Sea but plausibly in similar shallow water habitats in other seas (Jänes *et al.* 2015).

The Harris mud crab *Rhithropanopeus harrisii* was first found in Estonian waters in 2011. Further investigations in 2012 evidenced that the species has colonised whole Pärnu Bay and already occurring outside the area in the NE Gulf of Riga. There is no evidence on the further expansion of the distribution area of the species in 2015. Our experimental work indicates that the crab stayed more in vegetated boulders compared to unvegetated boulders or sandy habitats. There was an interactive effect between the presence of rey and crab population density with prey availability increasing the crab's affinity towards less favoured habitats when population densities were low. Increased aggression between crab individuals increased their affinity towards otherwise less occupied habitats. Less favoured habitats were typically inhabited by smaller individuals and presence of prey increased occupancy of some habitats for larger crabs. The experiment also demonstrated that the crab may inhabit a large variety of habitats with stronger affinity towards boulder fields covered with the brown macroalga *Fucus vesiculosus*. This implies stronger impact of crab in such habitats in the invaded ecosystem (Nurkse *et al.* 2015). *R. harrisii* significantly modifies meiobenthic communities and has by far the strongest effects on meiobenthos compared to any other environmental varible. The effects of *R. harrisii* varied among different habitats with the crab mostly modifying taxonomic composition and species abundances of meiobenthic communities mostly on unvegetated soft bottom sediments (Lokko *et al.* 2015).

Catch index of the Chinese mitten crab *Eriocheir sinensis* has been monitored in gillnet fishing nets in Muuga Bay (Gulf of Finland) since 1991. While until 2002, the species was relatively rarely found, significantly elevated catch index level was recorded since then. However, no or only a very few crabs were found in the bay during the past years (Figure 4; Anon 2016).

The round goby *Neogobius melanostomus* continues to increase in population abundance in the Gulf of Finland. The center of the distribution area is Muuga Bay where the species has increased exponentially since 2005 to until 2010, and this increase has slowed down during a few past years (Figure 4, Anon 2016). Pan-Baltic modelling results show that the distribution of the round goby is primarily related to local abiotic hydrological conditions (wave exposure). Furthermore, the probability of round goby occurrence was very high in areas in close proximity to large cargo ports. This links patterns of the round goby distribution in the Baltic Sea to shipping traffic and suggests that human factors together with natural environmental conditions are responsible for the spread of NIS at a regional sea scale (Kotta *et al.* 2016). In management, priority should be given to the establishment of a coordinated pan-Baltic monitoring programme and associated data storage and exchange, as well as the compilation of landing statistics. While eradication is unrealistic, population control that leads to minimising the risk of transfer to yet uncolonised areas in the Baltic Sea and adjacent waterbodies is feasible. This should comprise the requirement that the species be landed in commercial fishery bycatch, the management of ships' ballast water and sediments, and hull fouling of inland and sea-going vessels, including recreational boats (Ojaveer *et al.* 2015).

The gibel carp *Carassius gibelio* was introduced to fish ponds in Estonia during the mid-1950s and was first found in the sea in 1985. Out of the routinely investigated coastal fish monitoring stations, this non-indigenous fish is most abundant at the southern coast of Saaremaa (Kõiguste) in the northern Gulf of Riga with relatively stable values during the several past years (Figure 5, upper panel). During four past years, relatively high CPUE values were observed in the Gulf of Finland (Figure 5, lower panel). The fish occurs in several coastal fish monitoring sites at low abundances and is therefore considered as a common species in coastal fish communities.

4. Website

Multiple entries throughout the year to 'Information system of aquatic alien and cryptogenic species in Europe' (AquaNIS; www.corpi.ku.lt/databases/index.php/aquanis) to update the Baltic non-native species invasion events (first record by country, source region, pathway/vector responsible, species status, population status). Information of the invasion events module of the Baltic Sea is freely accessible.

5. Pathogens

Nothing to report.

6. Meetings (list of presentations)

Kotta, J., Kotta, I., Bick, A., Bastrop., R., Väinölä, R. (2015). Description, habitat range and seasonality of a new non-indigenous polychaete Laonome sp. (Sabellida, Sabellidae) the north-eastern Baltic Sea. 10th Baltic Sea Science Congress, 15–19 June 2015, Riga, Latvia.

Nurkse, K. (2015). Highlights of the recent round goby research in Estonia. Gobies as a model for invasion biology, evolutionary ecology, and reproductive strategies". A Marcus Wallenberg symposium held in Sweden, Umea, 24–27 February 2015.

Nurkse, K., Kotta, J., Orav-Kotta, H., Kotta, I., Pärnoja, M., Ojaveer, H. (2015). Invasive epibenthic predators' impact on benthic communities functioning. 10th Baltic Sea Science Congress, 15–19 June 2015, Riga, Latvia.

Ojaveer, H., Olenin, S., Minchin, D. and Boelens, R. 2015. Proposal for IMO Ballast Water Management Convention A-4 Target Species selection criteria. HELCOM Workshop on IMO BWMC target species, criteria and revision process (Tallinn, Estonia; 26 August 2015).

Ojaveer, H. (2015). AquaNIS in action: comprehensive overview on the non-indigenous species invasions and the vectors responsible in the Baltic Sea. 10th Baltic Sea Science Congress, 15–19 June 2015, Riga, Latvia.

Puntila, R., Granhag, L., Normant, M., Ojaveer, H., Strake, S. and Lehtiniemi, M. 2015. Baseline surveys of non-indigenous species in the Baltic Sea ports – Testing and evaluating the HELCOM-OSPAR Port Survey Protocol. ICES ASC (Copenhagen, Denmark 21–25. September 2015).

7. References and bibliography

Anon 2016. Operational monitoring of Estonian coastal sea. Estonian Marine Institute, University of Tartu. Final report, Tallinn.

AquaNIS 2016. Information system on aquatic non-indigenous and cryptogenic species http://www.corpi.ku.lt/databases/index.php/aquanis/manage/introductions_list/mode/m/bpid/229926/fl/R)

Herkül, K., Lauringson, V. & Kotta, J. (2016). Specialization among amphipods: the invasive *Gammarus tigrinus* has narrower niche space compared to native gammarids. Ecosphere, in press.

Jänes, H., Kotta, J. & Herkül, K. (2015). High fecundity and predation pressure of the invasive *Gammarus tigrinus* cause decline of indigenous gammarids. Estuarine Coastal and Shelf Science, 165, 185–189.

Kotta, J., Nurkse, K., Puntila, R. & Ojaveer, H. (2016). Shipping and natural environmental conditions determine the distribution of the invasive non-indigenous round goby *Neogobius melanostomus* in a regional sea. Estuarine, Coastal and Shelf Science 169: 15–24.

Kotta, J., Kotta, I., Bick, A., Bastrop, R. & Väinölä, R. (2015). Modelling habitat range and seasonality of a new, non-indigenous polychaete *Laonome* sp. (Sabellida, Sabellidae) in Pärnu Bay, the north-eastern Baltic Sea. Aquatic Invasions, 3, 275–285.

Kuprijanov, I., Kotta, J., Lauringson, V. & Herkül, K. (2015). Trophic interactions between native and alien palaemonid prawns and an alien gammarid in a brackish water ecosystem. Proceedings of the Estonian Academy of Sciences, 64, In press.

Lehtiniemi, M., Ojaveer, H., David, M., Galil, B.S., Gollasch, S., McKenzie, C., Minchin, D., Occhipinti-Ambrogi, A., Olenin, S. & Pederson, J. (2015). Dose of truth – Monitoring marine non-indigenous species to serve legislative requirements. Marine Policy 54: 26–35.

Lokko, K., Kotta, J., Orav-Kotta, H., Nurkse, K., Pärnoja, M. (2015). Introduction of a functionally novel consumer to a low diversity system: Effects of the mud crab *Rhithropanopeus harrisii* on meiobenthos. Estuarine, Coastal and Shelf Science. doi:10.1016/j.ecss.2015.11.017

Nurkse, K., Kotta, J., Orav-Kotta, H., Pärnoja, M., Kuprijanov, I. (2015). Laboratory analysis of the habitat occupancy of the crab *Rhithropanopeus harrisii* (Gould) in an invaded ecosystem: The north-eastern Baltic Sea. Estuarine, Costal and Shelf Science 154: 152–157.

Ojaveer, H., Galil, B.S., Lehtiniemi, M., Christoffersen, M., Clink, S., Florin, A., Gruszka, P., Puntila, R., Behrens, J.W. (2015). Twenty five years of invasion: management of the round goby *Neogobius melanostomus* in the Baltic Sea. Management of Biological Invasions, 6: 329–339.

Ojaveer, H., Galil, B.S., Campbell, M.L., Carlton, J.T., Canning-Clode, J., Cook, E.J., Davidson, A.D., Hewitt, C.L., Jelmert, A., Marchini, A., McKenzie, C.H., Minchin, D., Occhipinti-Ambrogi, A., Olenin, S. and Ruiz, G. 2015. Classification of non-indigenous species based on their impacts: considerations for application in marine management. PLOS Biol 13(4): e1002130. doi:10.1371/journal.pbio.1002130.

Plikshs, M. and Aleksejevs, E. 1998. Latvijas Daba. Zivis. Gandrs Publishers. Riga. 304 pp.

Reisalu, G.; Kotta, J.; Herkül, K.; Kotta, I. (2016). The invasive amphipod *Gammarus tigrinus* Sexton, 1939 displaces native gammarid amphipods from sheltered macrophyte habitats of the Gulf of Riga. Aquatic Invasions, 11, in press.

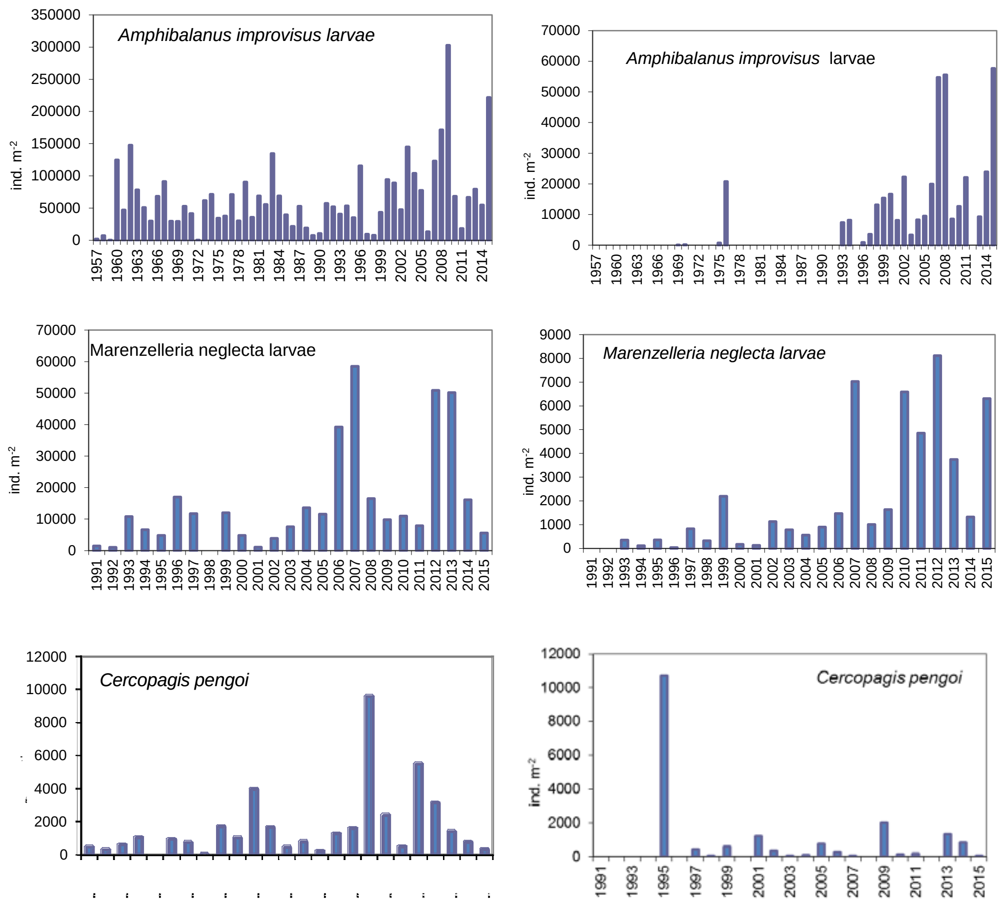


Figure 1. Long-term abundance dynamics of *Amphibalanus improvisus* larvae, *Marenzelleria neglecta* larvae and *Cercopagis pengoi* in the NE Gulf of Riga (left) and Tallinn and Muuga Bays, Gulf of Finland (right). Anon 2016.

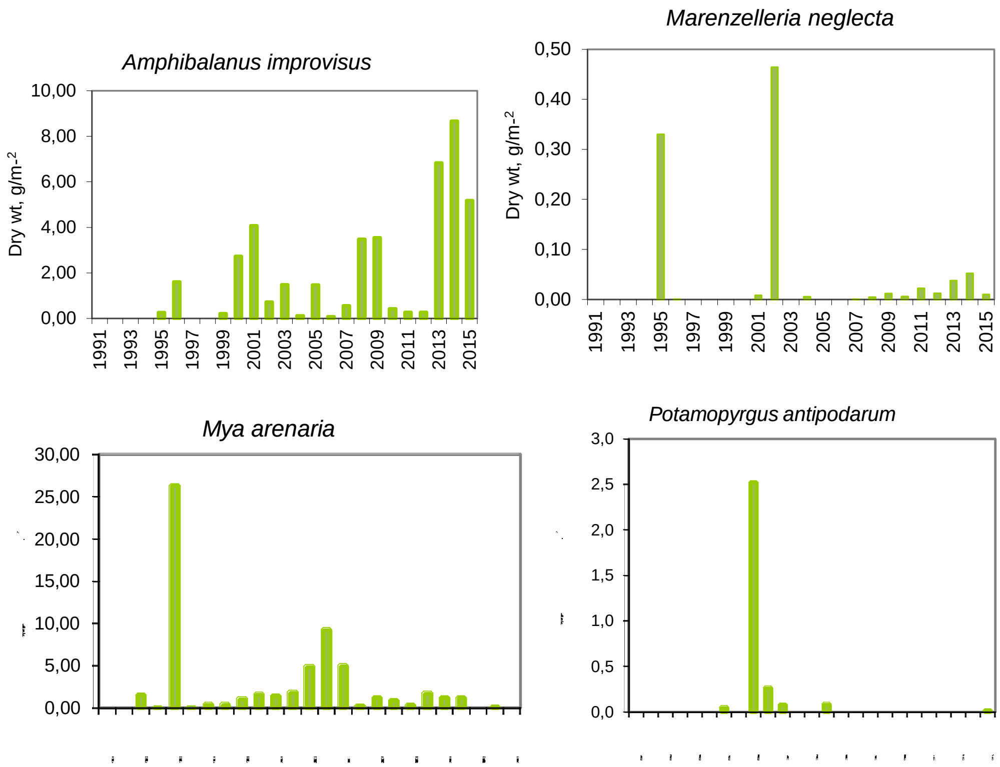


Figure 2. Long-term biomass dynamics of selected benthic non-indigenous and cryptogenic species in Tallinn and Muuga Bays (Gulf of Finland, Baltic Sea). Anon 2016.

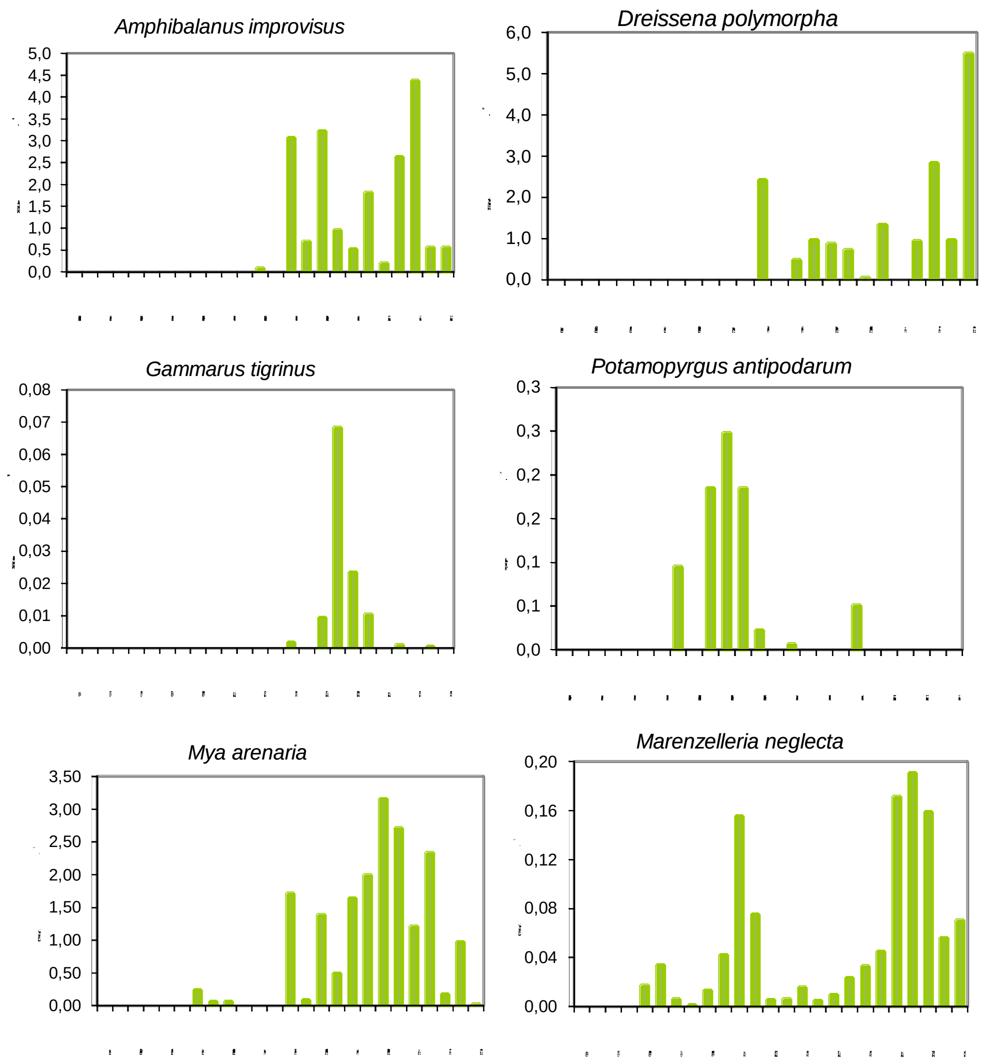


Figure 3. Long-term biomass dynamics of the selected benthic non-indigenous and cryptogenic species in the Gulf of Riga (Baltic Sea). Anon 2015.

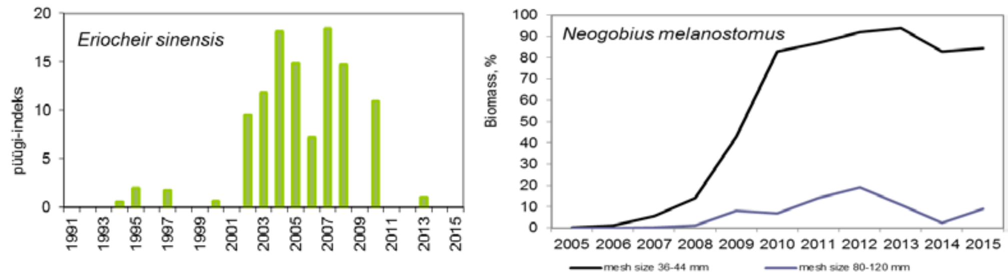


Figure 4. Catch index of the Chinese mitten crab *Eriocheir sinensis* (left panel) and percent contribution of the round goby *Neogobius melanostomus* (right panel) in experimental gillnet catches in Muuga Bay (Gulf of Finland, Baltic Sea) (Anon 2016).

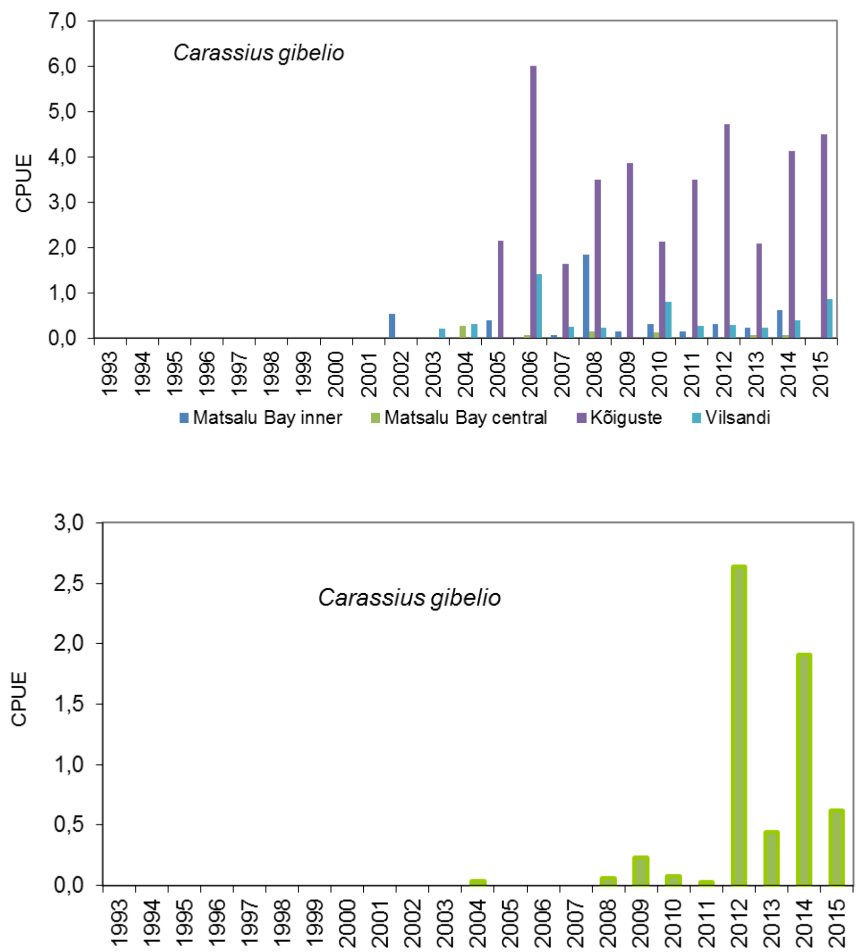


Figure 5. Catch per unit effort (CPUE) of gibel carp *Carassius gibelio* in various locations in Estonian coatsal sea: upper panel: Matsalu Bay (West-Estonian Archipelago Sea), Kõiguste (southern coast of Saaremaa in the Gulf of Riga), Vilsandi (west coast of Saaremaa Island) and lower panel: Käsmu (southern coast of the middle Gulf of Finland). Anon 2016.

Finland

Prepared by Maiju Lehtiniemi and Lauri Urho

Overview:

A new Finnish law on non-indigenous species was drawn. A *Laonome* species (Sabellidae) found in 2014–15 is yet unidentified. The Conrad's false mussel (*Mytilopsis leucophaeata)* and the gibel carp (*Carassius gibelio*) have extended their distribution.

Content:

1. Regulations:

The EU regulation on invasive species (2014) was taken into the national legislation during 2015 and the new Finnish law on non-indigenous species took force 1.1.2016.

Finland has been in the ratification process already years and is going to ratify the International Maritime Organization's International Convention for the Control and Management of Ships' Ballast Water and Sediments (the BWM Convention) during spring 2016. There have been expert hearings in the Parliament committees in November 2015 (Environment Committee) and February 2016 (Traffic and Communication Committee) and the decision on ratification should be ready soon.

2. Intentional:

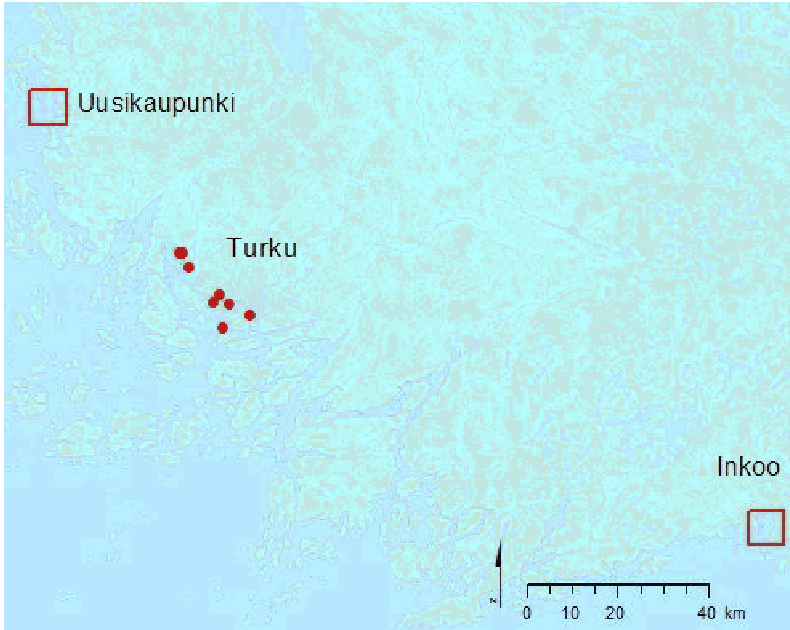
Synthesis of introductions

Deliberate releases into the Baltic Sea were (including rivers draining into the Baltic) for fisheries and fish stock enhancement purposes in 2015 as follows: 0.3 million newly hatched and 1.3 million older Atlantic salmon (*Salmo salar*), and 0.5 million newly hatched and 0.8 million older sea trout (*Salmo trutta* m. *trutta*), something around 34.7 million newly hatched and 7.6 million older whitefish (*Coregonus lavaretus*).

Rainbow trout (*Oncorhynchus mykiss*) were imported from Denmark for cultivation and European eel *(Anguilla* anguilla) from Sweden for stocking. Rainbow trout were exported to Sweden; whitefish (*Coregonus* spp.) to Sweden, Austria, Latvia and Italy; salmon to Sweden and Austria; grayling to Austria and German; arctic char to Sweden and Italy (TRACES).

3. Unintentional:

Not yet identified *Laonome* species (Sabellidae) was observed in southwest coastal area in three different locations Inkoo, Turku and Uusikaupunki in 2014/2015.



More information: VELMU-portal.

Previous Sightings

Conrad's false mussel (*Mytilopsis leucophaeata)* has been found to spread in the Archipelago Sea, Gulf of Finland and Bothnian Sea. Previously it has mainly inhabited the warm water discharge areas of the nuclear power plants in Loviisa (Gulf of Finland) and Olkiluoto (Bothnian Sea) but now it has been observed in many locations along the Finnish coast.

The gibel carp (*Carassius gibelio*) has been found to spread from the Archipelago Sea northwards to the Bothnian Sea and to ascend some more rivers in the Gulf of Finland.

Not Seen Species Yet

The Chinese (Amur) sleeper, *Perccottus glenii*, has not been observed in Finnish waters, although it is known to occur in the Russian side of the Gulf of Finland. *Pontogammarus robustoides* (Sars) has not been observed in Finnish waters although it is common in the Estonian coastal sea in Narva Bay, and in the Russian waters in the eastern Gulf of Finland. *Paramysis intermedia* (Czerniavsky) has not been recorded either, although it is present in the eastern Gulf of Finland.

4. Pathogens

No investigations on pathogens during 2015.

5. Meetings

- National meetings (board on invasive species issues, group on development of national NIS legislation, ad hoc group on BWMC implementation)
- HELCOM/OSPAR TG Ballast meetings
- Benthic Ecology meeting
- ICES Annual Science Conference

France

Compiled by Amelia Curd and Philippe Goulletquer (Ifremer) with contributions from Erwan Ar Gall & Sandrine Laurand (CNRS – University of Brest), Guy Bachelet & Antoine Nowaczyk (CNRS–University of Bordeaux), Jean-Claude Dauvin (CNRS – University of Caen), Laurent Guerin (MNHN – Dinard), Frédérique Viard (CNRS – Station Biologique de Roscoff), Thierry Vincent (ville du Havre), Marc Verlaque (CNRS – Mediterranean Institute of Oceanography), Herlé Goraguer & Laurence Miossec (Ifremer)

Highlights

This year the French "loi pour la reconquête de la biodiversité" which ratifies the Nagoya protocol will enter into force. This strictly regulates the sampling of all genetic material and the subsequent data availabiity. A new non-native genus was reported this year: the amphipod *Aoroides* spp. Specimens from three different species (*Aoroides semicurvatus, A. curvipes* and *A. longimerus*) were collected along the French Atlantic coast. This is the first time *Aoroides* spp. has been found in European marine waters (Gouillieux *et al.*, 2015). The other new sightings are the crab *Dyspanopeus sayi,* the gastropods *Nassarius cornicu-*

lum and *Gibbula ardens,* and the rhodophyte *Centroceras clavulatum* (Gully *et al.* 2013 ; Ruellet and Breton 2012 ; Le Duff and Ar Gall 2015). Recent studies of gelatinous zooplankton have shown the invasive comb-jelly *Mnemiopsis leidyi* to have an established population along the south-eastern coasts of the North Sea (David *et al.*, 2015), and the misidentification of *Nemopsis bachei, Blackfordia virginica* and *Maeotias marginata* (Nowaczyk *et al.* submitted) in the Gironde estuary. Genetic studies of the species complex *Ciona intestinalis* have revealed the co-occurrence in the English Channel of the invasive *Ciona robusta* (Bouchemousse *et al.* 2016) and the native *Ciona intestinalis.* The taxonomic revision of the former has recently been accepted. Consequently, there are many issues regarding the history, dynamics and fate of the recent (last 15–20 years) introduction of *C. robusta* in the native range of *C. intestinalis*).

1. Regulations

France will shortly be ratifying the Nagoya Protocol, which will be translated into French law by the "loi pour la reconquête de la biodiversité". This law, which will enter into force by the end of 2016, will strictly regulate access to all forms of genetic data. This law provides stricter constraints than the EU 2014 implementation of the Nagoya protocol. All samples of live material taken after 12 October 2014 (the date the Nagoya protocol was signed by the EU) should be registered in a Commission "genetic material" information system. With regard to private and public research activity, the French Ministry of Research will be the competent authority. As a result of this law, any genetic sampling studies will require permits from the Access Benefit Sharing Clearing House national focal points, and subsequent free access to results in the Commission registry. Other Member States should be aware of the commission implementing regulation (EU) 2015/1866, which will have similar national applications.

France's Marine Strategy Framework Directive (MSFD) monitoring programmes to monitor progress towards Good Environmental Status were published in June 2015. Each stage of the MSFD implementation must be reviewed every six years and revised if necessary. Concerning descriptor 2 non-indigenous species, recommendations are based on the works of national experts by the Museum National d'Histoire Naturelle. They concluded that more information is needed to better understand the abundance, distribution, vectors and pathways of introduction. High risk areas on which monitoring efforts should focus, namely ports, marinas, military zones and marine culture sites, have been identified. Options to monitor these areas are currently being considered, and should be tested (methods, protocols) before 2018, but will not be implemented until the second cycle of the MSFD monitoring programme (2021). Meanwhile the following existing monitoring activities will be reviewed by experts for their potential relevance:

- An Atlantic/Channel wide survey of *Bonamia ostreae* infections in the European flat oyster *Ostrea edulis* (REPAMO programme, coordinated by Ifremer)
- In the Channel, localized surveys of *Hemigrapsus* spp. (University of Caen), the slipper limpet *Crepidula fornicata* and wild Pacific oyster (*Crassostrea gigas*) reefs (HLiN program – Pien *et al.* 2015)
- In the Mediterranean, by *Caulerpa* spp. observatories and the IUCN MEDMIS program which monitors non-native species in marine protected areas

All national work for MSFD implementation for biodiversity and NIS are conducted in close connection with Regional Sea Conventions (OSPAR and UNEP/MAP for France). The program of measures that will contribute to the achievement and maintenance of GES including for D2 (NIS), is under construction and will be published in 2016.

2. Intentional

Algae

In the framework of the European project INVASIVES (see "Programmes" section), European distribution maps of 153 non-native macro-algal species were updated and are made available at http://invasives.b.uib.no/about-invasive-seaweeds/checklists-and-maps/. The distribution of conspicuous non-native species in France is recorded (e.g. *Undaria pinnatifida*, with a total number of 171 reports in Europe).

Annelida

A paper by Vincent *et al.* (2015) reveals that 47% of bait worms sold in France are non-native, with 7% originating from North America (*Glycera dibranchiatea*) and the remaining 40% (*Marphysa* sp., *Sipunculus* sp., *Paranereis acrata*, etc) come from Asian wholesalers, namely South Korea, Vietnam and China.

3. Unintentional

3.1 New Sightings

Crustacea

The Say's mud crab *Dyspanopeus sayi*, native to the Atlantic coast of North America, was reported for the first time in the Seudre estuary (Marennes-Oléron Bay, south-west France). In all, twenty-four crabs were collected from subtidal shelly, muddy bottoms located in the polyhaline part of the estuary in April and October 2007, and subsequently in October 2012 (Aubert and Sauriau, 2015).

The amphipod genus *Aoroides* is reported for the first time in European marine waters. Specimens of *Aoroides semicurvatus* and *Aoroides curvipes* were collected in oyster reefs in Arcachon Bay between 2009 and 2014 and in Hossegor Lake in 2014 (SW France). Specimens of *Aoroides longimerus* were collected in 2013 and 2014 in subtidal slipper limpet beds and *Zostera marina* meadows in Arcachon Bay and in 2014 on floating pontoons in the Bay of Brest (W France). These species, native to Asia, may have been accidentally introduced in Arcachon Bay and Hossegor Lake with oyster transfers, and into the Bay of Brest through both oyster transfers and shipping (Gouillieux *et al.*, 2015).

Mollusca

One live individual of the gastropod *Nassarius corniculum* was reported for the first time in Brittany, in the Trieux estuary in November 2013 (Gully *et al.*, 2013). To our knowledge, this is the first record of this species in Brittany. This dog whelk's natural distribution ranges from the Mediterranean to the Atlantic coast, from the Canary islands to Galicia. On the Atlantic coasts of France, it has been recorded in the Hossegor lagoon, where it was probably been introduced. It is hypothesized that *N. corniculum* was introduced via mariculture.

Algae

A red algal species, *Centroceras clavulatum* (Agardh) Montagne, was described for the first time in the Gulf of Morbihan (Le Duff and Ar Gall, 2015). This is also the first report of the occurrence of that species on the northern coasts of Europe. Its introduction is attributed either to movements of shellfish stock from the étang de Thau in the Mediterranean, where the species is present, or to an expansion of the species range north, as it has been observed on the Spanish Basque coast.

A review of the alien marine macrophytes in Tunisia (Sghaier *et al.*, 2016) reports the presence of *Hypnea cornuta* for the first time. Although it was only reported in one location, its casual status needs to be confirmed. The species could be more widely distributed in Tunisia as it can be easily confused with *H. spinella.*

Fish

A team of French ichtyologists carried out a survey of the alien fish species present in Cyprus in September 2014. Seven Lessepsian migrants (*Hippocampus fuscus, Nemipterus randalli, Ostorhinchus fasciatus* , *Parupeneus forsskali, Pomadasys stridens, Sphyraena obtusata* and *Spratelloides delicatulus* were recorded for the first time (Iglesias and Frotté, 2015).

3.2 Previous Sightings

Ctenophora

A recent paper by David *et al.* (2015) concludes that *Mnemiopsis leidyi* population has become established along south-eastern coasts of the North Sea where the environment conditions allow overwintering and it can be retained for later blooms.

Cnidaria

A recent (May 2013–May 2015) study of the gelatinous zooplankton in the Gironde estuary has revealed that three of the jellyfish species present are non-indigenous: *Nemopsis bachei, Blackfordia virginica* and *Maeotias marginata* (Nowaczyk *et al.* submitted). Although the former species was described in the Gironde estuary as far back as 1953 (Tiffon, 1956), since then no quantitative research has been carried out on jellyfish at the species level.

Mollusca

The veined rapa whelk *Rapana venosa* was observed for the first time on the French Mediterranean coast, in the étang de Berre (ECOREM 2015). This lagoon has recently been subject to an outbreak of the Manila clam *Ruditapes philippinarum* (Verlaque, pers.

comm.). The two events could be linked, with Manila clam spat (contaminated by *R. venosa*) from Venice acting as a possible vector .

Tunicata - taxonomic revision of Ciona intestinalis

Briefly, two invasive species *C. intestinalis* and *C. robusta* have now to be considered at a worldwide level. The English Channel (EC) is an area of special concern as the only sympatric area between the two species that has been so far confirmed. *C. robusta* is non-native in the NE Atlantic whereas *C. intestinalis* is considered to be native in this region.

The taxa known as *Ciona intestinalis* is composed of at least four cryptic species (Zhan *et al.* 2010), two of which occur in sympatry in Brittany. Based on molecular evidence (Nydam & Harison 2007, 2010, Zhan *et al.* 2010), the lack of hybrids in the sympatry area in the EC (Bouchemousse *et al.* (2016)) and morphological evidences (Brunetti *et al.* 2015), a taxonomic revision was agreed during the International Tunicates Meeting held in Aomori (Japan) in July 2015. *Ciona intestinalis* type B and *Ciona intestinalis* type A are now distinguished by the following names: *Ciona intestinalis* and *Ciona robusta* (changes made in WoRMS in September 2015), respectively. This is an important information to disseminate: 1) in many papers from diverse scientific fields (from ecology to evolutionary developmental biology), *Ciona intestinalis* is still the name mostly used even when the target species is *C. robusta*, 2) the invasive species list have to be updated with the distinction (e.g. in the Channel, the invasive species is *C. robusta*). The paper by Bouchemousse *et al.* (2016), funded by the Marinexus programme (see 2015 report) and the ANR project HySea (coord. F. Viard), which documented the rarity of F1-hybrids and the absence of other recent hybrids is now published (see reference list).

3.3 General Information

Programmes

The ANR project HySea (ANR-12-BSV7–0011; coord. F. Viard) started in November 2012 (end November 2016) targets the genomic processes involved in hybridization between related species that came into secondary contact, including recent secondary contacts due to human-aided transportation. Results from this project largely contributed towards providing the evidence that supported the taxonomic revision of the Ciona genus (see above). Among the non-native species targeted in this project are *Ciona robusta (*previously known as C. intestinalis type A, introduced in the N. Atlantic) and *C. intestinalis* (previously known as C. intestinalis type B and native in the N. Atlantic), *Crassostrea gigas* and *C. angulata*, in Europe. More information (in French only) can be found on the project website http://www.hysea-anr.fr/.

The project INVASIVES (2013–2016; coord. K. Sjutun) is a project carried out under the ERA-NET programme SEAS-ERA. This project aims at studying non-native macro-algae that have been introduced in European waters. It is devoted to ecological (habitat modelling, experimental ecology) and evolutionary (genetic diversity, adaptation) studies targeting major non-native macroalgae, for instance *S. muticum*. Information can be found here: http://invasives.b.uib.no/.

The monitoring network on non-native species in the Saint-Pierre and Miquelon archipelago is ongoing (Sellier *et al.*, 2016). A genetic analysis of individuals of green crab (*Carcinus maenas*) and the yellow sea squirt *Ciona intestinalis* are being carried out in collaboration with the DFO in order to understand population movements.

4. Pathogens

Nothing to report.

5. Meetings

Past year (2015)

The following meetings were either focused on non-native species or had non-native species sessions as part of their program:

Dauvin J.C. 2015. The English Channel: towards a new Japanese Sea. 16ème Symposium de la Société Franco-Japonaise d'Océanographie, The sea under human and natural impacts: challenge of oceanography to the future Earth. Tokyo, Japon, 17–21 November. Abstract com 13, 1 p.

Foveau A., Baffreau A., Pezy J.P., Bachelet G., Schlund E., & Dauvin J.C. 2015. First records of *Zeuxo holdichi* Bamber, 1990 (crustacea: tanaidacea) for the north Cotentin and eastern part of the Bay of Seine (France). RECIF Conference on artificial reefs: from materials to ecosystem, Caen, France, 27–29 January 2015, organised by ESITC Caen, abstract 1 p.

Ménez F. 2015. Manger l'autre: stratégies locales d'appréhension, d'appropriation et d'incorporation des espèces envahissantes. Le cas de la *Tapes philippinarum* en Vénétie, Italie. Projet de recherche ethnographique appliquée à d'autres espèces. Réunion GT-IBMA, 7 October 2015 (Conférence présentation 62p.)

Stiger-Pouvreau V., Le Lann K., Plouguerné E., Connan S. & Deslandes E. 2015. Distribution et expansion de l'algue rouge introduite *Grateloupia turuturu* sur le littoral des côtes ouest de la France – potentiel de valorisation ? EU project Seas-Eras Poster

Viard F. 2015. Secondary contacts of a native tunicate with an infertile native congener: a SNP-based investigation in Ciona sp. 8th International Tunicate Meeting (Aomori, Japan, 13–17 July 2015)

OSPAR Convention Meeting of the Intersessional Correspondence Group on the Coordi-nation of Biodiversity Assessment and Monitoring (ICG-COBAM) (Trondheim, Norway, 6–9 October 2015)

OSPAR ICG-COBAM (2) (London, United Kingdom, 1–3 December 2015)

Meetings in 2016

The following meetings are either focused on non-native species or have non-native species sessions as part of their programme:

- AIS (Aquatic Invasive Species) Monitoring Atlantic Zone meeting. (Northwest Atlantic Fisheries Centre, St Johns, Newfoundland, 10–11 February, 2016)

- OSPAR Biodiversity Committee (BDC) (Gothenburg, Sweden, 29 Feb.–4 March 2016)
- 19th International Conference on Aquatic Invasive Species (ICAIS), Winnipeg, Canada, 10–14 April 2016
- Marine and Freshwater Invasive Species, Buenos Aires, Argentina, 2–4 May 2016
- OSPAR ICG-COBAM (3) (Hamburg, Germany, 31 May–2 June 2016)
- Island Biology 2016 (Terceira Island, Azores, 18–22 July 2016)
- NEOBIOTA 2016 – 9th International Conference on Biological Invasions (Vianden, Luxembourg, 14–16 September 2016)

6. References and bibliography

Aubert F. & Sauriau, P.G. 2015. First record of Say's mud crab Dyspanopeus sayi (Smith, 1869) from the Seudre estuary (Marennes-Oléron, French Atlantic coast). An aod - les cahiers naturalistes de l'Observatoire marin, vol. IV (1), 2015 / 9–27.

Bouchemousse S., Lévêque L., Dubois G. & Viard F. 2016. Co-occurrence and reproductive synchrony do not ensure hybridization between an alien tunicate and its interfertile native congener. *Evolutionary Ecology* 30:69–87. doi : 10.1007/s10682–015–9788–1

CGDD, 2015. Analyse économique des espèces exotiques envahissantes en France Première enquête nationale (2009–2013), Études & documents N°130, Septembre 2015, 132p.

Copp G.H., Vilizzi L., Tilbury H., Stebbing P., Tarkan A.S., Miossec L. and Goulletquer, P. 2016. The Aquatic Species Invasiveness Screening Kit (AS-ISK): a generic risk identification tool for marine, brackish and freshwater taxa. Aquatic Conservation: Marine and Freshwater Ecosystems (submitted).

Comtet T., Sandionigi A., Viard F. & Casiraghi M. 2015. DNA (meta)barcoding of biological invasions: a powerful tool to elucidate invasion processes and help managing aliens. Biological Invasions 17, 905–922. doi:10.1007/s10530–015–0854-y

David C., Vaz S., Loots C., Antajan E., Molen J. & Travers-Trolet M. 2015. Understanding winter distribution and transport pathways of the invasive ctenophore *Mnemiopsis leidyi* in the North Sea: coupling habitat and dispersal modelling approaches . *Biological Invasions* 17(9), 2605–2619. doi:10.1007/s10530–015–0899-y.

De Montaudouin X., Arzul I., Caill-Milly N., Khayati A., Labrousse J.M.6, Lafitte C., Paillard C., Soudant P. and Goulletquer P., 2015. Asari Clam *Ruditapes philippinarum* in France 1972–2015. Worldwide Clam Conference– *Bulletin Fisheries Research Agency*, Japan, in press.

ECOREM 2015. Première observation de Rapana venosa confirmée. MedObs-Sub : news7 Retrieved from http://ecorem.fr/medobssub/wakka.php?wiki=news7 (accessed 3.4.16).

Galgani F. 2015. Marine Litter, future prospects for research. Frontiers in Marine Science, 26 October 2015 http://dx.doi.org/10.3389/fmars.2015.00087

Gouillieux B., Lavesque N., Leclerc J.-C., Le Garrec V., Viard F. & Bachelet G. 2015. Three non-indigenous species of Aoroides (Crustacea: Amphipoda: Aoridae) from the French Atlantic coast. *Journal of the Marine Biological Association of the United Kingdom* 1–9. doi:10.1017/S0025315415002027

Gully F., Cochu M. & Delemarre J.-L. 2013. Première observation du gastéropode *Nassarius corniculum* (Olivi, 1792) en Bretagne. An aod - les cahiers naturalistes de l'Observatoire marin II, 29–33.

Iglésias S.P. & Frotté L. 2015. Alien marine fishes in Cyprus: update and new records. *Aquatic Invasions* 10, 425–438.

Lallias D., Boudry P., Batista F.M., Beaumont A., King J.W., Turner J.R. and Lapègue S. 2015. Invasion genetics of the Pacific oyster *Crassostrea gigas* in the British Isles inferred from microsatellite and mitochondrial markers. *Biological Invasions* DOI 10.1007/s10530–015–0896–1

Le Bris A., Rosa P., Lerouxel A., Cognie B., Gernez P., Launeau P., Robin M. & Barillé L. 2016. Hyperspectral Remote Sensing of Wild Oyster Reefs*. Estuarine, Coastal and Shelf Science*, doi: 10.1016/j.ecss.2016.01.039

Le Duff M. & Ar Gall E., 2015. Première observation de l'algue rouge *Centroceras clavulatum* (Agardh) Montagne dans les eaux bretonnes et plus largement sur les côtes nord-européennes. *An Aod – les cahiers naturalistes de l'observatoire marin*, vol IV (1), 1–7.

Mineur M., Arenas F., Assis J., Davies A.J., Engelen A.H., Fernandes F., Malta E-J., Thibaut T., Van Nguyen T., Vaz-Pinto F., Vranken S., Serrão E.A. & De Clerck O. 2015. European seaweeds under pressure: Consequences for communities and ecosystem functioning. *Journal of Sea Research* **98**: 91–108. doi:10.1016/j.seares.2014.11.004

Nowaczyk A., David V., Lepage M., Goarant A., De Oliveira E. & Sautour B. 2016 Spatio-temporal patterns of three alien species of hydromedusae, *Blackfordia virginica* (Mayer, 1910), *Nemopsis bachei* (Agassiz, 1849) and *Maeotias marginata* (Modeer, 1791), in the Gironde estuary (France). *Aquatic Invasions.* Submitted.

Pien S., Maheux F., Dedieu K., Le Gendre R., Simon B.. & Gauquelin T. 2015. Ponte, Dispersion, Recrutement et Colonisation des huitres sauvages sur l'Ouest Cotentin : un réseau de suivi pour le littoral normand - étude de cas 2013, Projet HLiN (Huitres du Littoral Normand), 40p. http://archimer.ifremer/, http://www.smel.fr

Sellier M., Poitevin P., Goraguer H., Fauré J.M. & Goulletquer P. 2016. Suivi des espèces envahissantes marines à Saint Pierre et Miquelon Année 2014. Convention DTAM N°254 45p + annexes. http://archimer.ifremer.fr/doc/00312/42303/

Sghaier Y.R., Zakhama-Sraieb R., Mouelhi S., Vazquez M., Valle C., Ramos-Espla A.A., Astier J.M., Verlaque M. & Charfi-Cheikhrouha F. 2015. Review of alien marine macrophytes in Tunisia. *Mediterranean Marine Science* (in press). Available at: <http://www.medit-mar-sc.net/index.php/marine/article/view/1366>. Date accessed: 12 Feb. 2016.

Stiger-Pouvreau V. & Thouzeau G. 2015. Marine Species Introduced on the French Channel-Atlantic Coasts: A Review of Main Biological Invasions and Impacts. Open Journal of Ecology, 2015, 5, 227–257 Published Online May 2015 in SciRes. http://www.scirp.org/journal/oje http://dx.doi.org/10.4236/oje.2015.55019

Verlaque M., Ruitton S., Mineur F. & Boudouresque C.F. 2015. In: F. Briand (ed.) *CIESM Atlas of exotic species in the Mediterranean, Vol. 4 Macrophytes* – CIESM Publishers, Monaco, 364 p. ISBN 13: 978–92–990003–4-2

Vincent T. 2015. L'ethnologie du ver de vase sur le littoral de la Manche orientale, en particulier du Havre (Seine maritime): une histoire sociale mouvementée et une perspective écologique inquiétante. *Bulletin de la société des sciences naturelles de l'Ouest de la France*, 37(4): 219–231.

Wittman A. & Flores-Ferrer A. 2015. Analyse économique des espèces exotiques envahissantes en France. n°130. Collection "études et documents" du SEEIDD du CGDD. 132 pp.

Germany

Prepared by Stephan Gollasch and Katja Broeg

Overview:

Several non-indigenous species were newly recorded in German waters and the findings were added to AquaNIS (data entry January 2016):

- 2014 *Echinogammarus trichiatus* was found in the Stettin Lagoon (Germany, Mecklenburg-Western Pomerania) (Zettler 2015). This publication lists also other non-indigenous species from that Lagoon. We consider this lagoon as coastal waters adjacent to the Baltic Sea and many of these species were not yet known from the German Baltic coastal waters;
- 2014 *Hemigrapsus takanoi*, was recorded in the Baltic Sea for the first time (inner Kiel Fjord, Schleswig-Holstein) (Geburzi *et al.* 2015);
- 2014 *Synidotea laticauda* was found in the Port of Brunsbüttel (Schleswig-Holstein, North Sea) (Gesche Bock, Geomar, pers. comm.). This may not be the first records of this species in Germany as it was probably found earlier along the Lower Saxony coast;
- 2014 *Ficopomatus enigmaticus* was found in the Port of Schlutup (Schleswig-Holstein, Baltic Sea between Lübeck and Travemünde) (Gesche Bock, Geomar, pers. comm.);
- 2014 a single specimen of *Evadne anonyx* was found in the Kiel Bight. This is the first finding from German Baltic waters (Jörg Dutz, Leibniz Institute for Baltic Sea Research Warnemünde, pers. comm., Wasmund *et al.* 2015);
- 2015 *Dreissena rostriformis bugensis* was found in the Stettin Lagoon, which is possibly the first sighting of this species in German Baltic coastal waters (Michael Zettler, Leibniz Institute for Baltic Sea Research Warnemünde, pers. comm.) and;
- 2015 *Heterosiphonia japonica* was found at the German North Sea coast (Dagmar Lackschewitz, AWI, pers. comm.).

The non-indigenous diatom *Mediopyxis helysia* was first already recorded in spring 2009 in the backbarrier tidal flats of Spiekeroog, Island (North Sea). This finding only became known by a recent publication (Meier *et al.* 2015).

Intentional species introductions remain at a similar level as last year. A species not yet known from Germany is *Didemnum vexillum*, but it is found in other European countries. It may be possible that this species becomes introduced to German waters with movements of living mussels and aquaculture gear or in the biofouling of vessels.

Content:

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

No new German legislation was developed or implemented.

As reported last year, the Platform for Information Exchange on Neobiota continues with approximately semi-annual meetings. This platform facilitates the exchange of information in the framework of the "Federal and States Marine Monitoring Programme" the national body that takes care of the duties arising from national and international obligations. This work includes the development of a trend indicator (rate of new invasions) and an impact indicator (invasiveness) for Descriptor D2 of the Good Environmental Status (MSFD: 2008/56/EC).

To support the above mentioned activities a regular alien species monitoring programme was established along both, the German North and Baltic Sea coasts. A comprehensive summary of German coastal monitoring activities is available online at:

http://www.blmp-online.de/Seiten/Berichte.html

http://www.bsh.de/en/Marine_data/Observations/MURSYS_reporting_system/index.jsp

2. Intentional:

No major changes since last year's National Report. The species that were reported earlier include sturgeons, salmonids, rainbow trout, carps, *Crassostrea gigas, Homarus americanus* and the red alga *Palmaria palmata*.

Seed mussels (*Crassostrea gigas*) were imported to the northern Wadden Sea from Ireland, United Kingdom and the Netherlands.

3. Unintentional:

New Sightings

During a rapid assessment project of non-indigenous species in 2014 the research team of the Institute for Baltic Sea Research, Warnemünde (IOW) found the amphipod *Echinogammarus trichiatus* in the Stettin Lagoon (Germany, Mecklenburg-Western Pomerania) (Zettler 2015). The species was first recorded in Germany in the Danube River the 1990s and was spreading since. In September 2014 *E. trichiatus* was fort the first time recorded in the Stettin Lagoon near Kamminke and Zecherin (Germany, Mecklenburg-Western Pomerania). This finding represents the first record from German coastal waters adjacent to the Baltic Sea. Zettler (2015) lists other non-indigenous and longer established malacostracan species in the lagoon (the mysids *Limnomysis benedeni* and *Hemimysis anomala*, the amphipods *Chelicorophium curvispinum*, *Cryptorchestia cavimana*, *Dikerogammarus haemobaphes*, *D. villosus*, *Gammarus tigrinus*, *Obesogammarus crassus*, *Pontogammarus robustoides*, the isopod *Proasellus coxalis* and the decapods *Eriocheir sinensis* and *Orconectes limosus*).

In 2015 during a Rapid Assessment monitoring effort the red algae *Heterosiphonia japonica* was found at the German North Sea coast (Dagmar Lackschewitz, AWI, pers. comm.).

Hemigrapsus takanoi, a widespread non-indigenous species of the European Atlantic and North Sea coasts (northern Spain to southern Denmark), was in July 2014 recorded in the Baltic Sea for the first time (inner Kiel Fjord, Schleswig-Holstein) (Geburzi *et al.* 2015).

Synidotea laticauda was found in the Port of Brunsbüttel (Schleswig-Holstein, North Sea) in the "Ölhafen" and "Ostermoor". In Ostermoor a single specimen was already found in 2014, but at this time it was wrongly identified as *S. laevidorsalis*. In 2015 *S. laticuada* was found in both port areas in higher abundances on settling plates (Gesche Bock, Geomar, pers. comm.). This may not be the first records of this species in Germany as it was probably found earlier along the Lower Saxony coast.

Ficopomatus enigmaticus was in 2014 found in the Port of Schlutup (Schleswig-Holstein, Baltic Sea between Lübeck and Travemünde) (Gesche Bock, Geomar, pers. comm.). This represents the first record from the German Baltic coastal waters.

In 2014, a single specimen of *Evadne anonyx* was found in the Kiel Bight. This is the first finding from German Baltic waters (Jörg Dutz, Leibniz Institute for Baltic Sea Research Warnemünde, pers. comm., Wasmund *et al.* 2015).

Dreissena rostriformis bugensis was found in the Stettin Lagoon in 2015, which is possibly the first sighting of this species in German Baltic coastal waters (Michael Zettler, Leibniz Institute for Baltic Sea Research Warnemünde, pers. comm., see also next issue of the Lauterbornia journal).

The most up-to-date list of alien species in German coastal waters may be found at:

www.aquatic-aliens.de/species-directory.htm (site managed by Stefan Nehring) and in AquaNIS: http://www.corpi.ku.lt/databases/index.php/aquanis/.

Previous Sightings

Mytilopsis leucophaeata was for the first time recorded in German Baltic coastal waters (Odra Bank) in 2013 (Wasmund *et al.* 2014), but was not found again in 2014 (Wasmund *et al.* 2015).

It is interesting to note that two species were found on the drifting algae *Himanthalia* sp. near Helgoland. *Antithamnionella ternifolia* was observed on floating *Himanthalia* sp. on boulders (protective barrier) in front of the Helgoland Island harbour pier in August 2014. (in August 2012 *Watersipora subtorquata* was also found on this algae) (Kuhlenkamp & Kind pers. comm., PHYCOMARIN, Hamburg, Germany).

Schizobrachiella verrilli was found at four sites in the coastal waters of Belgium, the Netherlands and Germany. It is an encrusting cheilostomatous bryozoan unknown from Europe and was identified by microscopical and scanning electron microscope studies as *Schizobrachiella verrilli* (Cheilostomata, Schizoporellidae). Until now, it was only known from North America (Atlantic coast). A re-examination of historic samples confirmed the existence of *S. verrilli* in the North Sea since 1905. The first confirmed records in Germany are from 2011–2012. The few recent findings suggest that *S. verrilli* is a rare species living at sublittoral shell banks of the North Sea (Kind *et al.* 2015, Kuhlenkamp & Kind pers. comm., PHYCOMARIN, Hamburg, Germany).

Not Yet Seen Species

As reported last year, one species of special concern is *Didemnum vexillum*. This is found in European countries, but not yet known from the German coast. It may be possible that this species becomes introduced to German waters with movements of living mussels and aquaculture gear or in the biofouling of vessels. Scientists involved in monitoring programmes were made aware of this species.

4. Pathogens

No new findings were reported since last year's meeting.

5. Meetings

The "Platform for Information Exchange on Neobiota (NEOBIOTA)" had three meetings since the last WGITMO meeting and works towards a harmonized alien species monitoring programme to assess the EU MSFD Good Environmental Status (GES).

The Wadden Sea Alien Species Working Group (WG-AS) met twice in 2015. A list of Wadden Sea marine alien species has been compiled. As a living document, this list will be subject to continuous updating and is therefore an important element of the trilateral alien species management and action plan. The Common Wadden Sea Secretariat (CWSS), Wilhelmshaven, Germany website was suggested as a potential location to host the list which should also be linked with the NOBANIS website. What is still lacking is a list of terrestrial NIS. The next step will be a project for the development of a NIS monitoring and assessment programme for the Wadden Sea.

6. References and bibliography

Boestfleisch C, Drotleff AM, Ternes W, Nehring S, Pažoutová S, Papenbrock J. (2015): The invasive ergot *Claviceps purpurea* var. *spartinae* recently established in the European Wadden Sea on common cord grass is genetically homogeneous and the sclerotia contain high amounts of ergot alkaloids. – European Journal of Plant Pathology, 141: 445–461.

Borges LMS. 2014. Biodegradation of wood exposed in the marine environment: Evaluation of the hazard posed by marine wood-borers in fifteen European sites. International Biodeterioration & Biodegradation, 96, 97–104. http://dx.doi.org/10.1016/j.ibiod.2014.10.003.

Borges LMS, Sivrikaya H, Cragg SM. 2014. First records of the warm water shipworm *Teredo bartschi* Clapp, 1923 (Bivalvia, Teredinidae) in Mersin, southern Turkey and in Olhão, Portugal. BioInvasions Records (2014) Volume 3.

Briski E, Gollasch S, David M, Linley RD, Casas-Monroy O, Rajakaruna H, Bailey SA. (2015): Combining Ballast Water Exchange and Treatment to Maximize Prevention of Species Introductions to Freshwater Ecosystems. Environmental Science & Technology, 49(16), 9566–9573. DOI: 10.1021/acs.est.5b01795.

Cardeccia A, Marchini A, Occhipinti-Ambrogi A, Galil B, Minchin D, Narščius A, Ojaveer H, Olenin S, Gollasch S (in prep.): Assessing Biological Invasion of European Seas: biological traits of Most Widespread NIS.

César C, Essl F, Seebens H, Moser D, Pereira HM. (2015): The Dispersal of Alien Species Redefines Biogeography in the Anthropocene. Science, 348(6240): 1248–51.

Chainho P, Fernandes A, Amorim A, Avila SP, Canning-Clode J, Castro JJ, Costa AC, Costa JL, Cruz T, Gollasch S, Grazziotin-Soares C, Melo R, Micael J, Parente MI, Semedo J, Silva T, Sobral D, Sousa M, Torres P, Veloso V, Costa MJ. (2015): Non-indigenous species in Portuguese coastal areas, coastal lagoons, estuaries and islands. Estuarine, Coastal and Shelf Science 167(Part A), 199–211. DOI: 10.1016/j.ecss.2015.06.019.

Cornils A, Wend-Heckmann B. 2015. First report of the planktonic copepod *Oithona davisae* in the northern Wadden Sea (North Sea): Evidence for recent invasion? Helgol Mar Res. DOI 10.1007/s10152–015–0426–7.

David M, Gollasch S (unpublished): How to approach ballast water management in European seas. VECTORS Special Issue. (manuscript in preparation)

David M, Gollasch S, Penko L (unpublished): Identification of ballast water discharge profiles of a port to enable effective ballast water management and environmental studies. (submitted manuscript)

De Blauwe H, Kind B, Kuhlenkamp R, Cuperus J, van der Weide B, Kerckhof F (2014) Recent observations of the introduced *Fenestrulina delicia* Winston, Hayward and Craig, 2000 (Bryozoa) in Western Europe. Studi Trentini di Scienze Naturali, 94: 45–51

Dürselen, C.-D., T. Burgmer, T. Raabe, T. Meyer, D. Johannes (2014, in preparation for publication by Umweltbundesamt): Non-indigenous species (Descriptor 2). In: Dürselen, C.-D. (Ed.): Development of concepts and methods for compilation and assessment of selected anthropogenic pressures in the context of the Marine Strategy Framework Directive. German Federal Environment Agency (Umweltbundesamt), Final report Project No. (UFOPLAN) 3710 25 206, 3–84.

Essl F, Bacher S, Blackburn TM, Booy O, Brundu G, Brunel S, Cardoso A-C, Eschen R, Gallardo B, Galil B, García-Berthou E, Genovesi P, Groom Q, Harrower C, Hulme PE, Katsanevakis S, Kenis M, Kühn I, Kumschick S, Martinou AF, Nentwig W, O'Flynn C, Pagad S, Pergl J, Pyšek P, Rabitsch W, Richardson DM, Roques A, Roy HE, Scalera R, Schindler S, Seebens H, Vanderhoeven S, Vilà M, Wilson JRU, Zenetos A, Jeschke JM. (2015): Crossing Frontiers in Tackling Pathways of Biological Invasions. BioScience, 65(8): 769–82.

Gambill M, Friis Möller L, Peck MA, 2015. Effects of temperature on the feeding and growth of the larvae of the invasive ctenophore *Mnemiopsis leidyi*. J. Plankton Res. 5 pp. doi:10.1093/plankt/fbv039

Geburzi JC, Graumann G, Köhnk S, Brandis D (2015): First record of the Asian crab Hemigrapsus takanoi Asakura & Watanabe, 2005 (Decapoda, Brachyura, Varunidae) in the Baltic Sea. BioInvasions Records 4(2), 103–107

Gollasch S, David M, France J, Mozetič P. (2015): Quantifying indicatively living phytoplankton cells in ballast water samples – Recommendations for port State control. Marine Pollution Bulletin, 101, 768–775. DOI: 10.1016/j.marpolbul.2015.09.037.

Höher N, Turja R, Köhler A, Lehtonen KK, Broeg K. 2015. Immunological responses in the mussel *Mytilus trossulus* transplanted at the coastline of the northern Baltic Sea. Marine Environmental Research, 112, 113–121. http://dx.doi.org/10.1016/j.marenvres.2015.10.003

Jensen K, Zenetos A, Bishop J, Cook E, Edwards M, Faasse M, Florin A-B, Gittenberger A, Gollasch S, Goulletquer P, Huse V, Jelmert A, Leewis R, Nehring S, Stegenga H, Thomsen MS, Wood C (in prep.): Marine alien species in the Greater North Sea area: Updated species list with comments on introduction dates, status, distribution, and impacts in relation to the European Marine Strategy Framework Directive (MSFD).

Kind B, De Blauwe H, Faasse M, Kuhlenkamp R (2015). *Schizobrachiella verrilli* (Bryozoa, Cheilostomata) new to Europe. Marine Biodiversity Records, 8, e43 doi:10.1017/S1755267215000160

Kuhlenkamp R, Kind B., Schubert P, Bartsch I. (2015) WRRL-Bewertung N5 Helgoland 2014, Makrophyten Monitoring 2013–15. Water Framework Directive Monitoring – Component Macrophytobenthos N5 Helgoland, EQR Evaluation 2014; Final report March 2015. Report of the State Agency for Agriculture, Nature and Rural Areas (LLUR) of Schleswig-Holstein, Germany

Kuhlenkamp R, Kind B (2013). Arrival of the invasive *Watersipora subtorquata* (Bryozoa) at Helgoland (Germany, North Sea) on floating macroalgae (*Himanthalia*). Marine Biodiversity Records, 6, e73 doi:10.1017/S1755267213000481

Lackschewitz D, Reise K, Buschbaum C & Karez R (2014): Neobiota in deutschen Küstengewässern. Eingeschleppte und kryptogene Tier- und Pflanzenarten an der deutschen Nord- und Ostseeküste. Landesamt für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (LLUR). 216 pp. ISBN: 978–3-937937–73–1

Lehtiniemi M, Ojaveer H, David M, Galil B, Gollasch S, McKenzie C, Minchin D, Occhipinti-Ambrogi A, Olenin S, Pederson J. (2015): Dose of truth—Monitoring marine non-indigenous species to serve legislative requirements. Marine Policy 54, 26–35. DOI: 10.1016/j.marpol.2014.12.015

Leidenberger S, Obst M, Kulawik R, Stelzer K, Heyer K, Hardisty A, Bourlat SJ (2015) Evaluating the potential of ecological niche modelling as a component in marine non indigenous species risk assessments. Mar. Pollut. Bull. 97, 470–487.

Meier S, Muijsers F, Beck M, Badewien TH, Hillebrand H. 2015. Dominance of the non-indigenous diatom *Mediopyxis helysia* in Wadden Sea phytoplankton can be linked to broad tolerance to different Si and N supplies. Journal of Sea Research. 95, 36–44.

Meßner U, Zettler ML (2015) Die Quagga-Muschel *Dreissena* (*Pontodreissena*) *bugensis* (Andrusov, 1897) hat die Mecklenburgische Seenplatte und das Oderhaff erreicht (Bivalvia: Dreissenidae). [Engl.: The Quagga mussel *Dreissena* (*Pontodreissena*) *bugensis* (Andrusov, 1897) arrived the lakeland of north east Germany and the Stettin Lagoon (Bivalvia: Dreissenidae)]. Lauterbornia 80: 31–35

Nehring S, Essl F, Rabitsch W. 2015. Methodik der naturschutzfachlichen Invasivitätsbewertung für gebietsfremde Arten Version 1.3. BfN-Skripten 401, Bundesamt für Naturschutz, Bonn, Germany. 48 pp.

Nehring S, Rabitsch W, Kowarik I, Essl F (Eds.). 2015. Naturschutzfachliche Invasivitätsbewertungen für in Deutschland wild lebende gebietsfremde Wirbeltiere. BfN-Skripten 409, Bundesamt für Naturschutz, Bonn, Germany. 222 pp.

Roth H, Zettler, ML (2015) Morphologische und ökologische Eigenschaften allochthoner Mysida aus der Pontokaspis. [Engl.: Morphological and ecological characteristics of allochthonous Mysida with Pontocaspian origin]. Lauterbornia 80: 51–68

Seebens H, Essl F, Dawson W, Fuentes N, Moser D, Pergl J, Pyšek P, van Kleunen M, Weber E, Winter M, Blasius B. (2015): Global Trade Will Accelerate Plant Invasions in Emerging Economies under Climate Change. Global Change Biology 21: 4128–40.

van Kleunen M, Dawson W, Essl F, Pergl J, Winter M, Weber E, Kreft H, Weigelt P, Kartesz JT, Nishino M, Antonova LA, Barcelona JF, Cabezas FJ, Cárdenas D, Cárdenas-Toro J, Castaño N, Chacón E, Chatelain A, Ebel AL, Figueiredo E, Fuentes N, Groom QJ, Henderson L, Kupriyanov A, Masciadri S, Meerman J, Morozova O, Moser D, Nickrent DL, Patzelt A, Pelser PB, Baptiste MP, Poopath M, Schulze M, Seebens H, Shu W-S, Thomas J, Velayos M, Wieringa JJ, Pyšek P. (2015): Global Exchange and Accumulation of Non-Native Plants. Nature 525(7567): 100–103.

Wasmund N, Dutz J, Pollehne F, Siegel H, Zettler ML (2014): Biological Assessment of the Baltic Sea 2013. Meereswiss. Ber., Warnemünde, 94, 93 pp.

Wasmund N, Dutz J, Pollehne F, Siegel H, Zettler ML (2015): Biological Assessment of the Baltic Sea 2014. Meereswiss. Ber., Warnemünde, 97, 90 pp.

Werschkun B, Banerji S, Basurko OC, David M, Fuhr F, Gollasch S, Grummt T, Haarich M, Jha AN, Kacan S, Kehrer A, Linders J, Mesbahi E, Pughiuc D, Richardson SD, Schwarz-Schulz B, Shah A, Theobald N, von Gunten U, Wieck S, Höfer T. 2014. Emerging risks from ballast water treatment: The run-up to the International Ballast Water Management Convention. Chemosphere. 112, 256–266. http://dx.doi.org/10.1016/j.chemosphere.2014.03.135

Zettler ML (2015): Kurze Notiz über die Ankunft von Echinogammarus trichiatus im Ostseegebiet und den Erstnachweis von Paramysis lacustris in Deutschland [Short report on the arrival of *Echinogammarus trichiatus* in the Baltic Sea catchment area and the first record of Paramysis lacustris in Germany]. Lauterbornia 79: 151–156.

Israel

Prepared by Bella S. Galil

Note: This report does not reflect an official position or knowledge of the relevant Israeli Government bodies

Overview

The southern Levantine coast, located down-current of the Suez Canal opening into the Mediterranean, is under intense propagule pressure and consequently, hosts the highest number of established Erythraean alien species (Galil *et al.* 2016). Of the 31 species recorded between the ICES Working Group on Introduction and Transfers of Marine Organisms (WGITMO) in March 2012 and the present meeting, all but three are considered to have been introduced through the Suez Canal. The majority of the new records belong to the major introduced taxa in the Levant: 9, 8, 9 are mollusks, crustaceans and fish, respectively. All but eight are the earliest records for the Mediterranean Sea, highlighting the role of the southern Levant as a "hotspot", a beachhead and dispersal hub for their secondary spread.

The implication of a time lag between the first record and subsequent spread is that even were new introductions curtailed, populations of some Erythraean aliens already in the Levant are likely to increase and spread in future. The longer management of the Erythraean invasion is delayed, the larger the "invasion debt" we accrue.

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

-

2. Intentional introductions

-

3. Unintentional introductions

New alien species for the Israeli Mediterranean coast

Microsporidia

***Obruspora papernae* Diamant, Rothman, Goren, Galil, Yokes, Szitenberg & Huchon, 2014**

A gonadotropic microsporidian parasite, *Obruspora papernae* gen. et sp. nov. (Microsporidia: Enterocytozoonidae), was described from *Callionymus filamentosus*, a Red Sea invasive species which entered the Mediterranean through the Suez Canal and first collected off the Israeli coast in 1953, whereas its parasite went unobserved until 2008 (Diamant *et al.* 2015). Examination of museum specimens revealed that microsporidian lesions in Mediterranean dragonet ovaries due to *O. papernae* were noted in samples collected in 2004. The parasite-induced xenomas progressively occupied and eventually replaced much of the ovary, in some cases producing effective castration. As microsporidians are obligate parasites it stands to reason that this species too is an Erythraean alien. First record for the Mediterranean.

Macrophytes

***Antithamnionella elegans* (Berthold) J.H. Price & D.M. John, 1986**

This species has been introduced into the Mediterranean, probably by shipping, it is now widespread in the Mediterranean. In 2014 it was first collected along the Israeli shoreline from Ashkelon (31.6808N, 34.5539E) to Rosh HaNikra (33.0867N, 35.1055E). All specimens collected were found growing as epiphytes, exclusively attached on thalli of the red calcified seaweed *Ellisolandia elongata* (J.Ellis *&* Solander) K.R. Hind *&* G.W. Saunders, in the lower intertidal and shallow subtidal (Hoffman 2015).

Hypoglossum caloglossoides M.J.Wynne & Kraft 1985

In 2014 it was collected off Rosh HaNikra (33°5′21.59″N, 35°6′16.96″E) 3 m depth; Achziv Nature reserve (33°3′22.28″N, 35°6′8.06″E) 0.6–2 m depth, Shavei Zion (32°59′7.67″N, 35°4′53.15″E) 0.5 m depth, Haifa (32°49′56.7″N, 34°58′21.2″E) drift. In 2013 it was collected off Eilat, Red Sea (29°30′6.5″N, 34°55′4.44″E) at 6 m depth. All specimens were found in the shade of caves or under the rims of potholes in the intertidal zone. The authors (Hoffman & Wynne2015) suggest that since the species was found in the vicinity of Eilat and Haifa ports, that it was introduced by cargo vessels. First record for the Mediterranean.

Cnidaria

***Aequorea macrodactyla* (Brandt, 1835)**

This bioluminescent hydromedusa, common in the warmer waters in the East China Sea and recorded in the Red Sea and the Gulf of Eilat, was collected off Sdot Yam (32°29'35''N, 34°51'48''E) in June 2013, and in Haifa Bay (32°52'N, 35°01'E) in December 2013. The authors suggest that the species was transported by shipping from the Indo-Pacific to the Mediterranean (Mizrahi *et al.* 2015), I suggest it entered through the Suez Canal. First record for the Mediterranean.

***Cotylorhiza erythraea* Stiasny, 1920**

Photographs of live specimens were taken from a swarm present in July 2003 off Sdot Yam (32.492N, 34.882E), in July 2012, off Maagan Michael (32.559N, 34.905E), off Tel Aviv

(32.073N, 34.757E), and off Michmoret (32.407N, 34.864E). In July 2015, 18 specimens from a small aggregation off Michmoret (32.407N, 34.864E), were collected, and tissue samples were removed for DNA extractions. Both COI and 28S analyses revealed that *C. erythraea* is closest to the native Mediterranean cogener, *C. tuberculata*. The species was described from specimens collected in the early 20th C in the Suez Canal, and was later recorded along the Egyptian Red Sea. This is the first report of the species in the Mediterranean,

Crustacea

Actaea savignii (H. Milne Edwards, 1834)

A single female specimen of the Red Sea endemic xanthid crab, repeatedly reported from the Suez Canal and its lakes, was collected in Shikmona, at the southern margin of Haifa Bay (32°49'55.20"N 34°58'1.20"E) at depth of 6–10 m in December 2010. Subsequently it was collected off Mersin, south-eastern Turkey (36°11'36.81"N 33°45'55.37"E) in May 2011 (Karhan *et al.* 2013). This is the second xanthid of Red Sea origin recorded in the Mediterranean; first record for the Mediterranean.

Lucifer hanseni Nobili, 1905

The species, widely distributed in the IWP Ocean, has been amply recorded in the Suez Canal and its lakes, yet A single specimen collected in 1924 from Port Said harbour, Egypt, was hitherto the only record of the species in the Mediterranean Sea. It was first collected in Israel northeast of Ashdod (31°56.389N 34°41.76E) at depth of 10.8 m, in September 2008. Subsequently, it was collected off Herzliya, Maagan Michael and Ashdod at depths 5–35 m. The number of specimens, as well as the presence of mature males and females indicate that the species is likely established in the south-eastern Mediterranean. As one of the locations where the species was collected had been sampled by the same means, biannually, for many years, it is likely that the sudden appearance of the species results from a recent invasion through the Suez Canal (De Grave *et al.* 2012).

Lernanthropus callionymicola El-Rashidy & Boxshall, 2012

This ectoparasitic copepod was described from specimens of the Erythraean alien blotchfin dragonet, *Callionymus filamentosus,* collected from the Mediterranean coast of Egypt in 2010 and 2011 and from the Israeli coast in 2008. Yet, examination of museum specimens revealed that the parasite was first found in 1997 on the gills of dragonets collected off Palmahim, Israel (Diamant *et al.* 2015). This is the first record in the Mediterranean Sea.

Matuta victor (Fabricius, 1781)

Two specimens of the moon crab, widely distributed in the IWP, recorded in the Red Sea and the Gulf of Suez, were collected in Haifa Bay (32°83 N, 35°35 E, 32°85 N 35°07 E) at depth of 10 m, on sandy bottoms, in October and November 2012. As a predator of slow-moving benthic invertebrates, *M. victor* may influence the abundance and distribution of its prey items were it to achieve numerical abundance in Levantine sandy shores. This is the second moon crab of Red Sea origin recorded in the Mediterranean; first record for the Mediterranean (Galil & Mendelson 2013).

***Nikoides sibogae* De Man, 1918**

The nocturnal processid shrimp, widely distributed in the IWP but unknown from the Red Sea, was collected off Nizzanim (31°44.270N 34°32.630E-31°47.573N 34°34.768E) at a depth of 32 m, on sand-mud bottom, in June 2012, and in Haifa bay (32°52.440N 34°57.800E-32°51.280N 35°00.200E) at depths of 2 and 24 m, sand bottom, in November 2012. Half of the collected female specimens carried fertilized eggs, indicating an established local population. The authors suggest N. sibogae may have been introduced to the Mediterranean by shipping or aquarium trade (Levitt *et al.* 2014), I suggest it entered through the Suez Canal. first record for the Mediterranean.

***Paracaprella pusilla* Mayer, 1890**

The tropical western Atlantic skeleton shrimp was collected in March 2014 off Zikim (31°36'45''N, 34°30'16''E), associated with drifting colonies of the bryozoan *Bugula neritina* and with *Bugula* colonies attached to a submerged kurkar ridge. The species has been recorded previously from southwest Spain and marinas in the the Balearic Is., western Mediterranean. The Israeli record suggests that *P. pusilla* may also be present elsewhere in the Mediterranean (Ros *et al.* 2015).

***Saron marmoratus* (Olivier, 1811)**

A male 'marble shrimp', widely distributed in the Indo-Pacific, was photographed off Nahariya (33°02.032′N 35°04.261′E) at depth of 28 m, on a rocky knoll surrounded by coarse sand, in July 2013. The species is one of the most common forms of the Indo-West Pacific coral reefs, found on coarse coral rubble or under rocks. Given the species' presence in the Red Sea and the Gulf of Suez, it is suggested that it has entered the Mediterranean through the Suez Canal. First record for the Mediterranean (Rothman *et al.* 2013).

***Sicyonia lancifer* (Olivier, 1811)**

A single female of the widely distributed Indo-West Pacific rock shrimp was collected off Ashdod (31°50'6.9''N, 34°36'49''E) at a depth of 60 m, in June 2015. It was collected off the southern coast of Turkey earlier that same year. These records, at depths ranging 60–110 m, which marks the descent of thermophilic Erythraean aliens to the edge of the shelf (Gönülal *et al.* 2015).

Mollusca

***Costellipitar chordatum* (Römer, 1869)**

The small venerid bivalve is widely distributed in the IWP Ocean, from Japan and East China Sea to the Red Sea. Several specimens were collected off Nitzanim (31°44′N 34°34′E) at depth of 25 m, and at 37 m (31°49′N 34°35′E) in May 2012; off Soreq (31°56′N 34°41′E) at depth of 18–22.5 m in June 2012; Mikhmoret (32°24 ′N 34°51′E) at depth of 13 m in August 2014. Though the specimens are few in number, they were collected 90 km apart. It is quite likely that the species is already well established along the southern and central Mediterranean coast of Israel (Van Aartsen *et al.* 2015). This is the first record in the Mediterranean Sea.

***Cylichna villersii* (Audouin, 1826)**

The type specimens of this minute 'bubble snail' have been collected in Suez, and subsequently in the Great Bitter Lake, Suez Canal; it is endemic to the Red Sea. The earliest specimens of *C. villersii* collected off Hadera, at depths of 15–20 m, in October 1999. These were initially mistaken for juvenile *C. cylindracea*. Recently sampled off Ashdod (31°51N 34°38E), Soreq (31°57N 34°40E) and Haifa Bay (32°49N 35°01E) on sandy bottoms. The recent collection of many living specimens in several continuously sampled locations attests to the speed of its establishment in the south-eastern Levant (Bogi & Galil 2013b). This is the first record in the Mediterranean Sea.

***Goniobranchus obsoletus* Rüppell & Leuckart, 1830**

A single specimen of the Red Sea endemic sea slug was photographed off Tel Aviv (32.0667° N, 34.8000° E) in May 2015, several specimens were photographed in the same location in June 2015. A single specimen was photographed in Caesarea (32.5022° N, 34.9084° E), at depth of 6 m, in May 2015 (Halevy *et al.* 2015). This is the first record in the Mediterranean Sea.

***Gouldiopa consternans* (Oliver & Zuschin, 2001)**

The species was recorded in Singapore, Arabian Sea, Persian Gulf, Red Sea and Suez Canal, but is possibly widely distributed in the IWP Ocean. It was reported from Haifa Bay (32°54′N 35°04′E) in August 2011, and September 2013; Soreq (31°56′N 34°41′E) in June 2012, October 2012, October 2013, May 2014; Ashdod (31°51′N 34°39′E) in May 2012, October 2012, August 2013. Off the Israeli coast specimens were collected at depths ranging from 9.5 to 26.8 m, on sandy and sandy mud bottoms, and occurred in highly eutrophic and polluted sites adjacent to Haifa port and the Kishon estuary, and the outfall of the Dan Region Wastewater project. Since the Israeli sites are subject to annual or biannual monitoring of the shallow soft bottoms, it is assumed to be a very recent introduction. The large number of specimens, including numerous juveniles, collected in October 2012 and 2013 may signify this species as likely 'invasive' Van Aartsen *et al.* 2015). In 2012 the species was collected off Taşucu, Turkey. This is the first record in the Mediterranean Sea.

***Mimachlamys sanguinea* (Linnaeus, 1758)**

This Indo-Pacific species occurs throughout the Red Sea including the Gulf of Suez and the Bitter Lakes, Suez Canal, Egypt. It was collected off Ashqelon (31.6667°N, 34.5667°E), at depth of 13 m, on sand, in October 2011, and soon after off Palmahim (31.9327°N, 34.7069°E, 3 m depth, on sand between rocks, in November 2011 (Shefer *et al.* 2012).

This is the first record in the Mediterranean Sea.

***Monotygma watsoni* (Hornung & Mermod, 1927)**

A rare Red Sea endemic species, it was collected in several locations in Haifa Bay (ca. 31°49N 34°35E), at depths of 18.8- 37.2 m, in November 2011, and Palmahim (31°56.1772′N 34°40.9465′E) at depth of 22 m, in November 2012. The pyramidellids are minute heterobranch gastropods, ectoparasitic on a variety of invertebrate hosts. The large populations of a great number of Erythraean aliens in the Levantine Basin may serve as reservoir hosts for pyramidellids, many of which seem to be parasitic generalists, and may be introduced to native Mediterranean hosts (Bogi & Galil 2013a). It is the 14th Erythraean alien pyramidellid species recorded in the Levantine Basin; first record for the Mediterranean.

***Oscilla galilae* Bogi, Karhan & Yokeş, 2012**

A species new to science which cogeners are widely distributed in the IWP Ocean, it was described from specimens collected in Haifa Bay, Israel (32º54.544′N, 35º04.093′E) at depth of

10.5 m in May 2009; Carmel Reef, off Haifa (32°50.529′N, 34°56.637′E) at 21 m depth in November 2009; Port of Haifa (32°54.433′N, 35°01.661′E) at 25 m depth in April 2010, (32° 54.357′ N,35° 02.793′ E) at 20 m depth in December 2010. The earliest recorded specimen in the Mediterranean was collected off Taşucu, Mersin, Turkey (36°14.530′N, 33°48.359′E) at 5 m depth in November 2007 (Bogi *et al.* 2012).

***Pseudorhaphitoma iodolabiata* (Hornung & Mermod, 1928)**

A live juvenile specimen of the Red Sea endemic gastropod was collected in Haifa Bay (32°51′09″N, 35°01′23″E) at depth of 20.5 m, in April, 2010. The species was described from material collected in Massaua, southern Red Sea, in 1870. No other information of the species exists. *P. iodolabiata*, was collected in 2011 in Iskenderun Bay, Turkey. This is the first record in the Mediterranean Sea (Bogi & Galil 2012a).

***Trapania toddi* Rudman, 1987**

A single specimen of the Indo-West Pacific nudibranch was photographed in Akhziv Canyon (33°048 N, 35°103E) at a depth of 21 m in May 2014. The species was recorded from Suakin, Sudan, in the southern Red Sea. This is the first record in the Mediterranean Sea (Mienis *et al.* 2014).

Fish

***Cryptocentrus caeruleopunctatus* (Rüppell, 1830)**

The shrimp-associated goby, endemic to the Red Sea, was recorded in Rosh Ha'nikra-Achziv Nature Reserve at depths of 20–30 m (33°04′59″N 35°06′10″E). It was first observed in November, 2014. Since then, a colony of this species has been regularly observed at the same site. The burrows were found at 5–10 m distance intervals. Several burrows were less than 1 m apart. Occasional counts along transects of 100 m revealed 10 to 20 burrows per transect.

This is the sixth goby of Red Sea origin was recorded in Israel; first record for the Mediterranean (Rothman & Goren 2015).

***Epinephelus areolatus* (Forsskål, 1775)**

A specimen of the areolate grouper, widely distributed in the Indo-Pacific, including the Persian Gulf and the Red Sea, was fished off Tirat-Ha'Carmel (32°47'02"N, 34°54'02"E), at depth of 37 m in August, 2015. Genetic analysis (655bp fragment of the mitochondrial *COI*) established it is similar to specimens from the Indian Ocean, and differs from the western Pacific clade.

This is the sixth Indo-Pacific species belong to the genus *Epinephelus* Bloch, 1793 recorded in Israel; first record for the Mediterranean (Rothman *et al.* 2015)

***Epinephelus geoffroyi* (Klunzinger, 1870)**

The Red Sea spotted grouper, endemic to the Red Sea and the Gulf of Aden, was speared in a rocky habitat near Ga'ash (32º13′50″N, 34º48′59″E), at depth of 12 m, in January 2015. First record for the Mediterranean (Golani *et al.* 2015).

***Gymnothorax reticularis*, Bloch, 1795**

A single specimen of the reticulated moray eel, known from the Indian Ocean and the Red Sea, was fished off Rosh Hanikra (33°02' N, 35°04' E), at depth of 60 m, in January 2013. First record of the species in the Mediterranean and the first report of an alien Pacific muraenid in the Mediterranean (Stern & Goren, 2013).

***Heniochus intermedius* Steindachner, 1893**

A single specimen of the Red Sea Bannerfish, endemic to the Red Sea and the gulf of Aden, was speared off Sdot Yam (32º29′34.54′′N 34º53′14.40′′E), at depth of 6 m, in July 2014. Additional observations along the Israeli coast indicate that the species has established a local population (Tsadok *et al.* 2015). It was previously recorded from Turkey, Lebanon and Malta.

Parupeneus forsskali (Fourmanoir & Guézé, 1976)

The Red Sea goatfish, endemic to the Red Sea, was fished off Haifa Bay (32°51′01″N 34°56′13″E), at depth of 45 m, in January 2013. The species has been observed since the early 2000s at Mersin and Silifke, Turkey, as well as off the Israeli coast. In 2012 a specimen was collected off Lebanon (Sonin *et al.* 2013).

***Sardinella gibbosa* (Bleeker, 1849)**

Specimens of the goldstripe sardinella, widely distributed in the IWP and recorded in the Red Sea and the Gulf of Suez, has been collected off the southern Israeli coast since 2008. The specimens were misidentified as *S. maderensis*. This is the fifth clupeid of Red Sea origin recorded in Israel; first record for the Mediterranean (Stern *et al.*, 2015).

***Stolephorus indicus* (van Hasselt, 1823)**

The Indian anchovy, widely distributed in the IWP and recorded in the Red Sea, was fished btw Ga'ash (ca. 32°14'49'' N 34°49'03'' E) and Jaffa (ca. 32°02'49''N 34°44'22''E), in the upper 30 m above sand bottom, in May 2015. This is the second anchovy species to enter the Mediterranean through the Suez Canal, first record for the Mediterranean (Fricke *et al.*, 2015).

***Vanderhorstia mertensi* Klausewitz, 1974**

A single specimen of the Erythraean alien Mertens' prawn-goby was fished in Haifa Bay (32°54.632N 35°01.034E), at depth of 30 m, in November 2012. The species had been first reported in 2008 from Fethiye, Turkey, where it forma a flourishing population, and subsequently in several locations along the southern coast of Turkey. The rare specimen may suggest that the Israeli gobiid population is small as its habitat lies in heavily disturbed bottom trawled grounds (Goren *et al.* 2013).

Previous Sightings

Range expansions:

Bryozoa

***Amathia verticillata* (delle Chiaje, 1822)**

The widely dispersed stoloniferous fouling bryozoan was first recorded in Israel (as *Zoobotryon verticillatum*) in the early 1960s as occurring sometimes in huge colonies’ in Mikhmoret, in the vicinity of the naval school’s harbour. However, subsequent studies of the bryozoan fauna in the Levantine Basin have failed to record it in Israel, Lebanon, Turkey and Cyprus. It has been recently recorded from specimens collected from the hulls of vessels berthed in an Israeli marina. It is suggested the species is native to the Caribbean Sea, and an invasive alien elsewhere, including the Mediterranean Sea (Galil & Gevili 2014).

Crustacea

***Percnon gibbesi* (H. Milne Edwards, 1853)**

This is the most invasive decapod species to enter the Mediterranean Sea. A single specimen was photographed off the Israeli coast in 2009. In the past couple of years specimens, including ovigerous females, of this plagusiid crab were reported from several Israeli locations (Rosh HaNikra Nature Reserve (33.0886°N 35.1092°E) in November 2013, Akhziv National Park (33.0507°N 35.1031°E) in June 2014, north of Akhziv (33.0548°N 35.1031°E), in June 2015) suggesting the presence of a self-sustaining population in the southeast Mediterranean (Ilan *et al.* 2015)

Mollusca

***Elysia grandifolia* Kelaart, 1858**

The Indo-West Pacific sacoglossan opisthobranch, first recorded in the Mediterranean off Antalya, Turkey in 2001 and off Nahariya, Israel in 2005, has established a flourishing population along the Mediterranean coast of Israel. In August 2012 large numbers were observed on bryopsidacean covered rocky outcrops off the central Mediterranean coast of Israel (Mikhmoret 32.414526N, 34.8687E). Pairs of specimens and clusters of several individuals with extended penes may be copulatory aggregations (Pasternak & Galil 2012)

***Finella pupoides* Adams A., 1860**

The alien Erythraean gastropod *Finella pupoides* has been recorded at low abundance in the Eastern Mediterranean for over half a century. Recently, its populations along the southeastern Levantine coastline have grown extremely abundant. Samples collected in 2010–2011 off the coast of Israel contained up to 3300 ind/m^2 (Bogi & Galil, 2012b).

***Plocamopherus ocellatus* Rüppell & Leuckart, 1828**

A conspicuous but very rare Erythraean nudibranch, the species was first collected in the Mediterranean Sea off the Israeli coast in 1977, but no additional observations from Israeli waters were recorded in the scientific literature. Biodiversity assessment surveys of the hard bottom biota off Israeli coast and sightings by recreational divers/underwater photographers in the past dozen years seem to support the presence of a local self-sustaining population (Rothman & Galil 2015).

Fish

***Cheilodipterus novemstriatus* (Rüppell, 1838)**

The species was first recorded in the Mediterranean off Tel Aviv in June 2010. In the fall of 2011, individuals were spotted at the head of Rosh HaNikra canyon. In October 2012, a school numbering hundreds of adult specimens was photographed off Rosh HaNikra – a finding that confirms the presence of an established population of the species along the southern Levant (Rothman *et al.* 2012).

Nemipterus randalli **Russell 1986**

The first confirmed Mediterranean record of *N. randalli* (as *N. japonicus*) was collected off the Israeli coast in February 2005. Within 5 years from its first record, *N. randalli* has become one of the dominant components of the demersal littoral ichthyofauna in Israel, reaching an annual catch equal to 14.3% of the total bottom trawl catch. The population explosion began in fall 2008, and high values of abundance and biomass have been maintained to 2013 (Stern *et al.* 2014).

Stolephorus insularis **Hardenberg, 1933**

The first specimens of *S. insularis* recorded in the Mediterranean date back to 2009. Additional specimens were collected in 2012. The collection of yet more specimens in May 2015 indicates that its population may well be established in the eastern Mediterranean (Fricke *et al.* 2015).

4. Pathogens

Lernanthropus callionymicola **El-Rashidy & Boxshall, 2012**

Examination of museum specimens revealed that the parasite, first found on the gills of dragonets collected off Palmahim, Israel in 1997, is quite prevalent in later collections (Diamant *et al.* 2015).

Obruspora papernae **Diamant, Rothman, Goren, Galil, Yokes, Szitenberg & Huchon, 2014**

A gonadotropic microsporidian parasite, *Obruspora papernae* gen. et sp. nov., was described from *Callionymus filamentosus*, a Red Sea invasive species which entered the Mediterranean through the Suez Canal (Diamant *et al.* 2015). As microsporidians are obligate parasites it stands to reason that this species too is an Erythraean alien. The parasite-induced xenomas progressively occupied and eventually replaced much of the ovary, in some cases producing effective castration.

5. Meetings

None to report.

References and bibliography

Bogi C., Galil B.S., 2012a. First record of *Pseudorhaphitoma* cf. *iodolabiata* (Hornung & Mermod, 1928) (Mollusca; Gastropoda; Mangeliidae) off the Mediterranean coast of Israel. BioInvasions Rec 1(1): 33–35

Bogi C., Galil B., 2012b. *Finella pupoides* Adams A., 1860 (Gastropoda, Scaliolidae) – a population explosion underway, Mediterranean Sea. BioInvasions Rec 2(1): 43–45.

Bogi C., Karhan S.Ü., Yokeş M.B., 2012. *Oscilla galilae*, a new species of Pyramidellidae (Mollusca, Gastropoda, Heterobranchia) from the Eastern Mediterranean. Iberus 30(3): 1–6

Bogi C., Galil B.S., 2013a. *Monotygma watsoni*, a parasitic Erythraean alien pyramidellid (Mollusca, Gastropoda, Heterobranchia) newly recorded in the Mediterranean Sea. Mar Biodivers Rec 6; e80

Bogi C., Galil B.S., 2013b. *Cylichna villersii* (Audouin, 1826), an Erythraean cephalaspideid snail (Mollusca, Gastropoda, Opisthobranchia) in the Eastern Mediterranean. Mar Biodivers Rec 6; e92

Diamant A., Rothman S., Goren M., Galil B.S., klopman Y., Szitenberg A., Huchon D., 2014. A new xenoma-forming gonadotropic microsporidian (Microsporidia: Enterocytozoonidae) parasitic on the invasive Lessepsian dragonet, *Callionymus filamentosus* (Teleostei: Callionymidae): development, pathogenesis and epizootiology. Dis Aquat Organ 109: 35–54

De Grave S., Einav R., Galil B.S., 2012. Recent records of the Indo-Pacific species, *Lucifer hanseni* Nobili, 1905 (Crustacea; Decapoda; Luciferidae) from the Mediterranean coast of Israel. Bioinvasions Rec 1(2): 105–108

Fricke R., Golani D., Appelbaum-Golani B., 2015. First record of the Indian anchovy *Stolephorus indicus* (van Hasselt, 1823) (Clupeiformes: Engraulidae) in the Mediterranean Sea. Bioinvasions Rec 4: 293–297

Galil B.S., Mendelson M., 2013. A record of the moon crab *Matuta victor* (Fabricius, 1781) (Crustacea; Decapoda; Matutidae) from the Mediterranean coast of Israel. Bioinvasions Rec 2(1): 69–71

Galil B.S., Gevili R., 2014. *Zoobotryon verticillatum* (Delle Chiaje, 1822) (Bryozoa, Ctenostomatida, Vesiculariidae), a new occurrence in the Mediterranean coast of Israel. Mar Biodivers Rec 7; e17

Galil B.S., Gershwin L.A., Zorea M., Rahav A., Rothman B.S., Fine M., Lubinevsky H., Douek J., Paz G., Rinkevich B., 2016. *Cotylorhiza erythraea* Stiasny, 1920 (Scyphozoa: Rhizostomeae: Cepheidae), yet another Erythraean jellyfish from the Mediterranean coast of Israel. Marine Biodiversity doi:10.1007/s12526–016–0449–6.

Galil B.S., Marchini A., Occhipinti-Ambrogi A., 2016. East is East and west is west? Management of marine bioinvasions in the Mediterranean Sea. ECSS (online).

Golani D., Askarov G., Dashevsky Y., 2015. First record of the Red Sea spotted grouper, *Epinephelus geoffroyi* (Klunzinger, 1870) (Serranidae) in the Mediterranean. Bioinvasions Rec 4(2):143–145

Gönülal O., Lubinevsky H., Galil B.S., 2015. The first Indo-West Pacific rock shrimp (Crustacea, Decapoda, Sicyoniidae) in the Mediterranean Sea. Bioinvasions Rec 5

Goren M., Stern N., Galil B.S., 2013. Bridging the gap: first record of Mertens' prawn-goby *Vanderhorstia mertensi* in Israel. Mar Biodivers Rec 6; e63

Halevy Y., Barchana D., Twina K., Lavi Y., Ben Zvi E., Rothman S., Mienis H.K., 2015. First records of *Goniobranchus obsoletus* from the Mediterranean coast of Israel. Triton 32: 1–3

Hoffman R., 2015. Occurrence of *Antithamnionella elegans* (Ceramiales, Rhodophyta) on the Mediterranean shore of Israel Medit Mar Sci 16(2): 477–478

Hoffman R., Wynne M.J., 2015. First reports of the red alga *Hypoglossum caloglossoides* from the Mediterranean and the Red Sea. Bot Mar 58(4): 321–325

Ilan M., Shlagman A., Goren L., Shema T., Galil B.S., 2015. A population of *Percnon gibbesi* (H. Milne Edwards, 1853) (Crustacea: Decapoda: Plagusiidae) along the Israeli coastline, southeast Mediterranean. Bioinvasions Rec 4(4): 289–291

Karhan S.Ü., Yokeş M.B., Clark P.F., Galil B.S., 2013. First Mediterranean record of *Actaea savignii* (H. Milne Edwards, 1834) (Crustacea: Decapoda: Brachyura: Xanthidae), an additional alien Erythraean crab. Bioinvasions Rec 2(2): 145–148.

Levitt Y., De grave S., Shenkar N., 2014. First record of an invasive shrimp from the family Processidae (Crustacea, Decapoda) in the Mediterranean Sea. Med Mar Sci 15(3):650–653

Mienis H.K., Elayani J., Rothman B.S., 2014. The first record of *Trapania toddi* Rudman, 1987 from the Mediterranean Sea off Israel. Triton 30:1–2.

Mizrahi G.A., Shemesh E., van Ofwegen L., Tchernov D., 2015. First record of *Aequorea macrodactyla* (Cnidaria, Hydrozoa) from the Israeli coast of the eastern Mediterranean Sea, an alien species indicating invasive pathways. NeoBiota 26: 55–70

Pasternak G., Galil B.S., 2012. An established population of the alien sea slug *Elysia grandifolia* Kelaart, 1858 (Mollusca, Opisthobranchia, Elysiidae) off the Mediterranean coast of Israel. Bioinvasions Rec 1(3): 221–223

Ros M., Guerra-García J.M., Hoffman R., 2015. First record of the exotic caprellid amphipod *Paracaprella pusilla* Mayer, 1890 in the eastern Mediterranean Mar Biodiv DOI 10.1007/s12526–015–0311–2

Rothman B.S., Goren M., Galil B.S., 2012. On the rapid establishment of the Indian Ocean twospot cardinalfish along the Levantine coast of the Mediterranean Sea. Bioinvasions Rec 2(1): 85–88.

Rothman S., Shlagman A., Galil B.S., 2013. *Saron marmoratus* (Olivier, 1811), an Indo-Pacific marble shrimp (Hippolytidae, Decapoda, Crustacea) in the Mediterranean Sea. Mar Biodivers Rec 6; e129

Rothman S., Galil B.S., 2015. Not so rare: *Plocampherus ocellatus* (Nudibranchia, Polyceridae) in the Eastern Mediterranean. Mar Biodivers Rec 8; e144

Rothman S., Goren M., 2015. First record of the Red Sea shrimp-goby *Cryptocentrus caeruleopunctatu*s in the Mediterranean Sea. Mar Biodivers Rec 8: e157

Rothman S., Stern N., Goren M., 2015. First record of the Indo-Pacific areolate grouper *Epinephelus areolatus* (Forsskål, 1775) (Perciformes: Serranidae: Epinephelinae) in the Mediterranean Sea. Zootaxa 4067(4)

Shefer S., Feldstein T., Mienis H.K., Rittner O., Gur A., 2012. First records of *Mimachlamys sanguinea* (Linnaeus, 1758) from the Mediterranean coast of Israel (Bivalvia, Pectinidae). Triton 25:1–2

Sonin O., Salameh P., Edelist D., Golani D., 2013. First record of the Red Sea goatfish, *Parupeneus forsskali* (Perciformes: Mullidae) from the Mediterranean coast of Israel. Mar Biodivers Rec 6; e105

Stern N., Goren M., 2013. First record of the moray eel *Gymnothorax reticularis*, Bloch, 1795 in the Mediterranean Sea, with a note on its taxonomy and distribution. Zootaxa 3641(2): 197–200

Stern N., Levitt Y., Galil B.S., Diamant A., Yokeş M.B., Goren M., 2014. Distribution and population structure of the alien Indo-Pacific Randall's threadfin bream *Nemipterus randalli* in the Eastern Mediterranean. J Fish Biol doi:10.1111/jfb.12421

Stern N, Rinkevich B, Goren M (2015) First record of the Goldstripe sardinella - *Sardinella gibbosa* (Bleeker, 1849) in the Mediterranean Sea and confirmation for its presence in the Red Sea. Bioinvasions Rec 4(1): 47–51

Tsadok R, Shemesh E, Popovich Y, Sabag Y, Golani D, Tcheronov D (2015) New record and occurrence of the Red Sea bannerfish, *Heniochus intermedius* (Actinopterygii: Perciformes: Chaetodontidae), in the Mediterranean. Acta Ichthyol Piscat 45 (3): 331–333

Van Aartsen J.J., Galil B., Bogi C., 2015. Two alien venerid bivalves from the Eastern Mediterranean. Mar Biodivers Rec 8; e83

Italy

[1] **Prepared by Anna Occhipinti-Ambrogi, with assistance of Balistreri Paolo (Palermo), Bianchi Carlo Nike (Genova), Bertasi Fabio (Roma), Brunetti Riccardo (Padova), Caronni Sarah (Pavia and Sassari), Castriota Luca (Palermo), Cecere Ester (Taranto), Ceccherelli Giulia (Sassari), Ferrario Jasmine (Pavia), Gambi Maria Cristina (Ischia), Marchini Agnese (Pavia), Petrocelli Antonella (Taranto), Relini Giulio (Genova), Relini Orsi Lidia (Genova), Sarà Gianluca (Palermo)**

Overview

One new species of algae, one jellyfish, two bryozoans, one amphipod, two shrimps and two fish species have been recorded for the first time along the Italian coasts. The amphipod record represents also the first finding in the Mediterranean Sea and the bryozoan *Watersipora arcuata* is the first record for the European seas. A few already established species continued to extend their distribution.

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

No information.

2. Intentional introduction

No new intentional introductions have been reported.

3. Unintentional introduction

New Sightings

Algae & higher plants

Spermothamnion cymosusm has been collected from the Lagoon of Venice (Isola della Certosa,

45.439921° N, 12.375376° E, October 2010). The native area of this red alga is the Pacific Ocean and it was reported until now from Australia only. It was identified using both morphological observations and molecular analysis (Armeli Minicante, 2013).

---

[1] **Note:** This report is the outcome of a special working group of the Italian Marine Biology Society (SIBM) on a voluntary basis. It does not reflect an official position or knowledge of the relevant Italian Government bodies.

It has been prepared according with the guidelines for ICES WGITMO National Reports; it updates the Italian status of 2015.

Invertebrates

A large specimen of *Rhopilema nomadica* (with an umbrella of ≈40 cm in diameter) was observed floating close to a rocky bottom in Pantelleria Island (36.74416° N; 11.98222° E) at 7 m depth on 19 September 2015 (Balistreri & Ghelia, 2015). Another single specimen of *R. nomadica* was sighted off Cagliari (Sardinia) on 27 October 2015 and the finding was reported on local press [2]. These two records constitute the first sightings of *R. nomadica* in Italy, and may represent the onset of a possible spreading of this noxious species to the northern areas of the central Mediterranean Sea.

Ferrario *et al.* (2015) reported the first record of the cheilostome bryozoan *Watersipora arcuata* in the Mediterranean Sea, namely from a marina of the Ligurian Sea (Italy), during two monitoring surveys carried out in 2013 and 2014, representing also the first European finding to date. The species, whose native origin is deemed to be the Tropical Eastern Pacific region, was already reported as being introduced to California, Australia, New Zealand and Hawaii, but not outside the Pacific Ocean. The sampling site was the marina of Santa Margherita Ligure, frequented by tourist boats and located about 35 km south-east of Genoa.

The ascophoran bryozoan *Celleporaria brunnea* was detected for the first time in 2010 and 2011 in different locations in the western Mediterranean Sea (Lodola *et al.*, 2015). The species is presumably native to the Pacific coasts of North America and is distributed from British Columbia to the Galapagos Islands (Ecuador). In the Mediterranean Sea, *C. brunnea* was first recorded in Turkey and later reported along the Lebanese coasts. The finding in the Italian harbours of La Spezia (Liguria), Olbia (Sardinia) and Lampedusa (off Sicily) marks its western and northernmost occurrence within the Mediterranean basin.
More recently (2013 and 2014) the species was also found in the Taranto Gulf on artificial plates (Lezzi *et al.*, 2015).

The aorid amphipod *Grandidierella japonica*, native to the Western Pacific region and known as introduced species from the Atlantic coasts of Europe, was collected from the docks of the marina of Viareggio (Tuscany, Tyrrhenian Sea) in July 2013 (Marchini *et al.*, 2015a). More than 200 specimens were collected in 7 stations of the innermost (brackish water) part of the marina (43.55° N; 10.30° E). This constitutes the first Mediterranean record of the species.
The brown shrimp *Penaeus aztecus* was found in the Tyrrhenian Sea: one female was collected in August 2014 on muddy bottoms near Castiglione della Pescaia (42°42.258′N; 10°53.716′E) at a depth of 70 m. A male specimen was collected in November 2014, in Follonica Gulf (42°51.146′N; 10°39.000′E) by trawling at a depth of 40 m (Cruscanti *et al.* 2015).

---

[2]http://lanuovasardegna.gelocal.it/cagliari/cronaca/2015/10/27/news/avvistata-nelle-acque-della-sardegna-una-pericolosa-medusa-gigante-del-mar-rosso-1.12340691

The green tiger shrimp *Penaeus semisulcatus* was recorded from observations of commercial catches in the Gulf of Taranto. Over 150 individuals were identified from September to December 2014 (Arnesano *et al.*, 2015)

Fish

The occurrence of the doctorfish *Acanthurus chirurgus* was reported by Langeneck *et al.* (2015b) for the first time in the Mediterranean Sea, off Elba Island, Tyrrhenian Sea (42.726667° N; 10.434444° E). This record is tentatively related to aquarium release.

The barred knifejaw *Oplegnathus fasciatus*, native to Asian waters, was first recorded in the Mediterranean Sea by Schembri *et al.* (2010). In September 2015 a specimen was caught in Trieste (45.61135° N; 13.78649° E) by a local fisherman who photographed it (Ciriaco and Lipej, 2015).

Previous Sightings

Algae & higher plants

Chrysophaeum taylorii (Pelagophyceae) is an allochthonous benthic microalga recently

recorded in the Mediterranean Sea where it is spreading quickly. Caronni *et al.* (2014) studied cell abundance at different spatial and temporal scales along the north western Sardinia coast. No direct dependence of the production of mucilage on the density of *C. taylorii* cells can be hypothesized for the lack of a significant direct correlation of their relative abundance. Furthermore, Caronni *et al.* (2015a) performed a five year study in the same area on substratum and depth preferences of this bloom-forming mucilaginous microalga. Abundance of *C. taylorii* was significantly higher on rocks than on all the other types of biotic and abiotic substrata. Throughout the sampling period and at all sites, the abundance of *C. taylorii* showed a marked decrease with depth. The results indicate that substratum complexity is unimportant, as similar cell abundances were observed on bare vs. already colonized substrata.

The actual distribution of the Indo-Pacific alien red alga *Hypnea cornuta* was assessed by the high resolution multispectral satellite remote sensing technique in the Mar Piccolo of Taranto, where it was found in December 2000 for the first time (Cecere *et al.*, 2015).

The composition and structure of epifaunal assemblages associated with the red alga *Gracilaria vermiculophylla* was compared with those associated with the native *Ulva rigida*.in a Northern Adriatic lagoon (Munari *et al.*, 2015). The more complex *G. vermiculophylla* fronds supported higher species richness and diversity of the associated macrofauna.

The ALien Biotic IndEX (ALEX - from Çinar and Bakir, 2014) was used to evaluate biological invasions in sessile macroalgae assemblages of Mediterranean hard bottom habitats (Piazzi *et al.*, 2015).

The invasion of *Caulerpa taxifolia* var. *dysticophylla* on *Posidonia* meadows caused a modification of the original composition of the associated invertebrate, both macro- and meiofauna, according to Musco *et al.* (2015).

Bulleri and Malquori (2015) investigated tolerance of *Caulerpa cylindracea*, one of the most successful invaders in the Mediterranean, in the face of intense consumption by native herbivores. By means of a field experiment along the coast of Leghorn (Tyrrhenian Sea) they tested whether regeneration from damaged creeping stolons may allow *C. cylindracea* to compensate or overcompensate for biomass loss. The results showed that growth rates of *Caulerpa* in quadrats were always positive and increased with the intensity of the initial experimental damage.

Caronni *et al.* (2015b) tested the hypothesis that the spread of an introduced alga at disturbed, degraded seagrass canopy sites is dependent on the lack of large consumers. They experimentally mimicked the degradation of the native *Posidonia oceanica* canopy and transplanted *Caulerpa racemosa (=cylindracea)* into each plot whereby excluding large fishes from half of them. The study provided evidence that different invasion prediction can be made based on the size of the consumers present and that the resistance to invasion is dependent on the conservation status of both competitors and consumers. Alterations to the structure of the seagrass canopies are likely to enhance the spread of *C. racemosa* only when large consumers are absent.

Montefalcone *et al.* (2015) reviewed the distribution of *Caulerpa taxifolia* and *C. cylindracea* over the last 30 years in the Italian side of the Ligurian Sea and compared the kinetics of their spreading. *C. taxifolia* had an impressive expansion phase from 1984 to 2000, but then its dispersal rate showed lower than that predicted and the species did not persist in areas formerly colonized. Today, the abundance of this species, recorded for the first time in Italian waters in 1992 (Relini and Torchia, 1992), is strongly declined as it disappeared from most of the attained areas. On the contrary, *C. cylindracea* exhibited an impressive and constant expansion from the beginning of its first appearance in the Ligurian Sea (Bussotti *et al.*, 1996) and it is still increasing its range and habitat occupancy.

Invertebrates

The polychaete *Pseudonereis anomala* was reported in the Sicilian harbours of Augusta and Siracusa (Ionian coast) (D'Alessandro, 2015).
The occurrence of the spionid polychaete *Polydora cornuta* in North Adriatic lagoons: is reported by Bertasi (2016): since the taxonomic status of this species is yet under scrutiny, we prefer to consider it a cryptogenic species.

The crab *Eriocheir sinensis* has been found for the second time in the Lagoon of Venice and off the mouth of the Stella river in the Lagoon of Marano and Grado (Bettoso and Comisso, 2015).
Several individuals of the isopod *Paranthura japonica*, recently recorded on Italian coasts, have been collected from the Mar Piccolo basin of Taranto (Lorenti *et al.*, 2015).
An abundant population of the mud crab *Rhithropanopeus harrisii*, has been studied in the brackish-water canals between the towns of Pisa and Livorno (Langenek *et al.*, 2015a).

Callinectes sapidus was collected in the Laguna of Grado [3] and in the Sacca di Goro, a coastal lagoon of the Po river delta, where occasional spottings of the blue crab in past years have been numerous (Manfrin *et al.*, 2015). The species was also reported from the lagoons of Lesina and Varano (southern Adriatic) by Cilenti *et al.* (2015).
The crayfish *Procambarus clarckii*, present in the whole Crati river system, was found also at the "Foce del Crati" Natural Regional Reserve in 2009, showing to thrive best also in transitional waters (Sperone *et al.*, 2015).

The northernmost record of the nudibranch *Godiva quadricolor* was reported from the Ligurian Sea, inside the Site of Community Importance 'Fondali Noli – Bergeggi' at a depth of 3.5 m (Betti *et al.*, 2015). This species, described in 1927 in South Africa, had been previously recorded in two coastal lakes, Fusaro (Tyrrhenian Sea - Cervera *et al.* 2010) and Piallassa Baiona (Adriatic Sea - Rinaldi 2012, as *Facelina auriculata*).
Two individuals of the nudibranch *Polycerella emertoni*, previously reported from other Italian localities Italy, were found in Olbia Gulf on November 2013, representing the first record of the species in Sardinia (Trainito and Doneddu, 2015).
Several specimens of the opistobranch, *Haminoea cyanomarginata* were observed in October 2014 at 23–30 m depth off Palinuro (Salerno) on different algal species and *Posidonia oceanica* leaves (Tiberti *et al.*, 2015).
Six specimens of another opistobranch *Bursatella leachii* were observed on October 2014 in the Northern part of the lagoon of Venice. One of them, transported in the laboratory, produced typical string-like egg masses that hatched after a few days (Monteraele Gavazzi *et al.*, 2015).

Crocetta (2015) reports the finding of *Arcuatula senhousia* from mussel aquaculture farms off Lake Miseno near Naples.
The role of ecoimmunology, i.e. how immunological effectors of invasive species play a role in addressing new colonization, has been stressed by an article by Parisi *et al.* (2015), who identified an antimicrobial peptide (defensin) from the mussel *Brachidontes faraonis* colonizing the Salina Ettore, a salt pond in western Sicily.

Barbieri *et al.* (2016) provided molecular insight into the phylogeographic structure of *Pinctada imbricata radiata* in the Eastern Mediterranean Sea. An analysis was conducted on individuals collected from seven Mediterranean localities (Israel to Malta), along with some sequences from its native range. This work confirmed the hypothesis that individuals of this species (one of the first established in the Mediterranean after the opening of the Suez Canal) should be characterised by low levels of genetic heterogeneity. The study highlighted that a demographic expansion of *P. imbricata radiata* occurred in the Mediterranean study area. The trend of the mismatch distribution suggests the demographic expansion is very recent or even ongoing.

The genetic diversity of the ascidian *Styela plicata* was analysed employing the mitochondrial COI gene on 149 individuals collected in 14 ports along the Italian coasts. The re-

[3] http://ilpiccolo.gelocal.it/trieste/cronaca/2015/10/31/news/l-arrivo-nel-golfo-di-trieste-del-feroce-granchio-blu-1.12362501

sults suggest multiple introductions of *S. plicata*, although rapid expansion from few founding individuals with reduced genetic diversity is evident in some locations (Maltagliati *et al.*, 2015).

A paper from Brunetti *et al.* (2015) demonstrates that two different species were named *Ciona intestinalis* in the past. They are differentiated on the basis of both molecular and morphological characters and correspond to a previously synonymized species (*Ciona robusta*, described from a Japanese specimen) and to *C. intestinalis sensu stricto*. Despite the Japanese type locality of *C. robusta*, its Pacific native origin is questionable (for example, it is reported as invasive in Korea: Lee & Shin, 2014). Therefore, its presence in Italy should be considered cryptogenic, until new evidences permit a more precise definition of its status.

Fish

The reticulated leatherjacket, *Stephanolepis diaspros* introduced through the Suez Canal, is expanding within the Strait of Sicily, as documented from records of the species from coastal waters off the Maltese Islands, between August 2007 and May 2011; in addition, a first record from the Egadi Islands was recorded (Balistreri and Parasporo, 2015), and a second validated record was registered in December 2013 from the island of Lampedusa in the Pelagian Islands (Deidun *et al.*, 2015).

A single specimen, 1.5 m long, of *Fistularia commersonii* was seen and video-recorded on 22 November 2014 in Ischia (Naples) at 15 m depth, with a water temperature of 20°C (Tiberti *et al.*, 2015).

Studies on the genetic variability of *Fistularia commersonii* were performed via mitochondrial sequencing of the Mediterranean specimens (Sanna *et al.*, 2015). The data suggest that a limited number of mitochondrial lineages passed through the Suez Canal. However, nuclear markers provide a scenario with a high genetic variability among the Mediterranean *F. commersonii* migrants, along with the occurrence of haplotype sharing between the Mediterranean and the Red Sea. The analysis was carried out by sequencing mitochondrial D-loop I in individuals from Sardinia, Sicily, Tunisia, Lampedusa, Libya and Lebanon; the results suggest the possible occurrence of two mitochondrial lineages.

Species not yet seen

Numerous individuals of the euryleptid flatworm *Maritigrella fuscopunctata* were observed by snorkeling during July and September 2015 at three different coastal localities in Malta. To date, *M. fuscopunctata* was mainly known from Western Australia, Maldives, Indonesia and Micronesia (see Newman & Cannon, 2000). *M. fuscopunctata* had not been previously recorded from the Mediterranean Sea (Portelli *et al.*, 2015).

Natural range expanding species

A specimen of the problematic genus *Kyphosus* is reported off Favignana Island, Sicily, central Mediterranean Sea (Mannino *et al.*, 2015). The authors identified it as *K. vaigienis* on the basis of mitochondrial DNA sequences (COI and 16S-rDNA), but state that the analysis of nuclear gene sequences would be needed to better clarify the identification. Two, perhaps three, *Kyphosus* species—*K. bigibbus, K. sectatrix* and *K. vaigiensis*—have been occasionally recorded in the Mediterranean Sea. These species occur both in the Atlantic and Indo-Pacific regions but it is likely they entered the Mediterranean through the Strait of Gibraltar. However, it is unclear whether this species has established reproductive native populations in the Mediterranean.

The following species, not included in previous reviews (Table 2: Occhipinti *et al.* 2011) have been quoted by Sperone *et al.* (2015) in their compilation of NIS records from Calabria: *Zenopsis conchifera, Pseunes pellucidus, Sphoeroides pachygaster.* These species had already been spotted in Italian waters while a single female specimen of a murenid fish, which the Authors have classified as *Gymnothorax moringa*, might be the first record for the Mediterranean.

The fangtooth moray, *Enchelycore anatina* (Lowe, 1838), native to the eastern Atlantic Ocean but also known from eastern sections of the Mediterranean, was reported in Sicilian waters by Consoli and Mazza (2014). This species, which in recent years has been increasing its distribution across the Mediterranean Sea, was first recorded in Italy (Ionian Sea) by Guidetti *et al.* (2012).

4. Pathogens

No new information

5. Meetings and research projects

An updated list of NIS recorded in the Lagoon of Venice, providing information on the date of first record, native origin, likely vector of introduction and population status was published by Marchini *et al.* (2015b). The number of NIS introduced in the Venetian lagoon currently totals 71, out of which 55 are established. The linear increase in the number of introduced species observed for all NIS and for established NIS suggests alarming future scenarios. The continuous input of exotic biota and particularly of successful invaders in such a ''sink and source'' site constitutes a threat to the marine ecosystem not only on a local scale, but also at the Mediterranean and European levels.

Parravicini *et al.* (2015) reviewed warm-water native and alien species richness in relation with the warming of the Mediterranean Sea and analysed quantitative data collected in the early 1990s and late 2000s that indicated a decrease in the cover of warm-water native species on shallow rocky reefs and an increase in deeper waters.

In national/regional datasets of alien species the criteria for the inclusion of records are seldom explicit, and frequently inconsistent in their definitions, spatial and temporal frames and comprehensiveness. Agreed-upon uniform guiding principles, based on solid and transparent scientific criteria, are advocated by Marchini *et al.* (2015c) in order to provide policy makers with validated and comparable data. Following a meta-analysis on the records of marine alien species in the Mediterranean Sea, they recommend a judicious approach to compiling the data, identifying 3 categories of uncertainty: species' taxonomic identification, species' actual occurrence in the area, and their status as an alien. They propose guiding principles to standardize such datasets, and logical, standardized and transparent criteria to substantiate records of alien species.

The following regional projects have been accomplished:

- The RITMARE Project "Integrated environmental characterization of the contaminated marine coastal area of Taranto, Ionian Sea" that has considered inter alia the biological pollution by alien species, issued a special publication (Cecere *et al.*, 2015);

- The BIODIVALUE Project "Biodiversity and Sustainable Development in the Strait of Sicily" was funded by the O.P. Italia-Malta, under the scientific responsibility of Franco Andaloro;
- The Sicilian Region funded a Regional Observatory on biodiversity through the EU Structural Funds under the scientific responsibility of Andaloro Franco;
- The BALMAS Project "Ballast water management system for Adriatic Sea protection". IPA Adriatic Cross-border Cooperation Programme 2007–2013, under the scientific responsibility of Erika Magaletti is currently underway;
- The MITO Project " Multimedia Information for Territorial Objects" funded by the EU Structural Funds under the scientific responsibility of Claudio Maricchiolo (ISPRA, Rome), provided a cell phone app to signal NIS.

6. References and bibliography

Armeli Minicante S., 2013. Biodiversità della Laguna di Venezia e della costa nord adriatica veneta. Segnalazioni (220). Boll. Mus. St. Nat. Venezia, 64: 143–144.

Arnesano M., Gaudio P., Zupa W., Casciaro L., Carbonara P., 2015. Presence of *Penaeus semisulcatus* (Decapoda Penaeidae) in the North-western Ionian Sea (Central Mediterranean). Biol. Mar. Mediterr., 22(1): 157–159.

Balistreri P., Ghelia M., 2015. First record of *Rhopilema nomadica* from Italy. In: Crocetta *et al.* New Mediterranean Biodiversity Records (October 2015). Medit. Mar. Sci., 16/3: 685.

Balistreri P., Parasporo M., 2015. First record of *Stephanolepis diaspros* (Tetraodontiformes, Monacanthidae) from the Egadi Islands Marine Protected Area (western Sicily). In K. Tsiamis *et al.* New Mediterranean Biodiversity Records (July 2015). Medit. Mar. Sci., 16/2, 483.

Barbieri M., Deidun A., Maltagliati F., Castelli A., 2016. A contribution to the phylogeography of *Pinctada imbricata radiata* (Leach, 1814) (Bivalvia: Pteriidae) from the Eastern Mediterranean Sea by means of the mitochondrial COI marker. Ital. J. Zool., 83(1): 113–120.

Bertasi F., 2016. The occurrence of the alien species *Polydora cornuta* Bosc, 1802 (Polychaeta: Spionidae) in North Adriatic lagoons: an overlooked presence. Ital. J. Zool., 83(1): 77–88.

Betti F., Cattaneo-Vietti R., Bava S., 2015. Northernmost record of *Godiva quadricolor* (Gastropoda: Nudibranchia) in the SCI "Fondali Noli – Bergeggi" (Ligurian Sea). Marine Biodiversity Records, page 1 of 4. doi:10.1017/S1755267215000032; Vol. 8; e26; 2015

Bettoso N., Comisso G., 2015. First record of the Chinese mitten crab (*Eriocheir sinensis*) in the lagoon of Marano and Grado (Northern Adriatic Sea). Annales Ser. Hist. nat., 25: 29–34.

Brunetti R., Gissi C., Pennati R., Caicci F., Gasparini F., Manni L. *et al.*, 2015. Morphological evidence that the molecularly determined *Ciona intestinalis* type A and type B are different species: *Ciona robusta* and *Ciona intestinalis* . J. Zool. Syst. Evol. Res., 53 (3): 186–193.

Bulleri F., Malquori F., 2015. High tolerance to simulated herbivory in the clonal seaweed, *Caulerpa cylindracea*. Mar. Environ. Res., 107 (2015) 61–65.

Bussotti S., Conti M., Guidetti P., Martini F., Matricardi G., 1996. First record of *Caulerpa racemosa* (Forskål) J. Agardh along the coast of Genoa (North-western Mediterranean). Doriana, (Suppl. Annuali Museo Civico di Storia Naturale 'G. Doria' di Genova), 6 (294): 1–5.

Caronni S., Delaria M.A., Navone A., Panzalis P., Sechi N., Ceccherelli G., 2014. Relevant scales of variability of the benthic allochthonous microalga *Chrysophaeum taylorii*. Mar. Biol, 161:1787–1798.

Caronni S., Bresciani A., Delaria M.A., Meloni F., Navone A., Panzalis P., Heimann K., Ceccherelli G., 2015a. Ecology of the benthic mucilage-forming microalga *Chrysophaeum taylorii* in the Western Mediterranean Sea: substratum and depth preferences. Estuar. Coast. Shelf S., 161: 38–45.

Caronni .S, Calabretti C., Delaria M.A., Bernardi G., Navone A., Occhipinti-Ambrogi A., Panzalis P., Ceccherelli G., 2015b. Consumer depletion alters seagrass resistance to an invasive macroalga. PLOS ONE DOI:10.1371/journal.pone.0115858 February 27, 2015

Cecere E., Petrocelli A., Belmonte M., Portacci G., Rubino F., 2015. Activities and vectors responsible for the biological pollution in the Taranto Seas (Mediterranean Sea, southern Italy): a review. Environ. Sci. Pollut. Res., DOI 10.1007/s11356–015–5056–8

Cervera J.L., Tamsouri N., Moukrim A., Villani G., 2010. New records of two alien opisthobranch molluscs from the north-eastern Atlantic: *Polycera hedgpethi* and *Godiva quadricolor*. Marine Biodiversity Records 3, e51 page 1 of 4. doi:10.1017/S1755267210000102.

Çinar, M.E., Bakir, K., 2014. ALien Biotic IndEX (ALEX) – a new index for assessing impacts of alien species on benthic communities. Mar. Pollut. Bull., 87: 171–179.

Cilenti, L., Pazienza, G., Scirocco, T., Fabbrocini, A., & D'Adamo, R. (2015). First record of ovigerous *Callinectes sapidus* (Rathbun, 1896) in the Gargano Lagoons (south-west Adriatic Sea). BioInvasions Records, 4(4): 281–287.

Ciriaco S., Lipej L., 2015. First record of *Oplegnathus fasciatus* from Italy and the Adriatic Sea. In: Crocetta *et al.* New Mediterranean Biodiversity Records (October 2015). Medit. Mar. Sci., 16/3: 686.

Consoli P., Mazza G., 2014. New record of the fangtooth moray *Enchelycore anatina* (Lowe, 1838) from Sicilian waters (central Mediterranean Sea): 677 p. In: Katsanevekis *et al.* New Mediterranean Biodiversity Records (October 2014). Mediterranean Marine Science 15 (3): 667–687.

Crocetta F., 2015. *Arcuatula senhousia* reaches Campania (central Tyrrhenian Sea). In: Crocetta *et al.* New Mediterranean Biodiversity Records (October 2015). Medit. Mar. Sci., 16/3: 685–686.

Crocetta F., Agius D., Balistreri P., Bariche M., Bayhan Y.K., Çakir M., Ciriaco S., Corsini-Foka M., Deidun A., El Zrelli R., Ergüden D., Evans J., Ghelia M., Giavasi M., Kleitou P., Kondylatos G., Lipej L., Mifsud C., Özvaro Y., Pagano A., Portelli P., Poursanidis D., Rabaoui L., Schembri P.J., Taşkin E., Tiralongo F., Zenetos A., 2015 New Mediterranean Biodiversity Records (October 2015) Medit. Mar. Sci. DOI: http://dx.doi.org/10.12681/mms.1477

Cruscanti M., Innocenti G., Bremer J.A., Galil B.S., 2015. First report of the brown shrimp *Penaeus aztecus* Ives, 1891 (Crustacea, Decapoda, Penaeidae) in the Tyrrhenian Sea. Marine Biodiversity Records, 8, doi:10.1017/S1755267215000664

D'Alessandro M., L. Castriota, P. Consoli, Romeo T., Andaloro F., 2015. *Pseudonereis anomala* (Polychaeta, Nereididae) expands its range westward: first Italian record in Augusta and Siracusa harbours. Mar. Biodiv. DOI 10.1007/s12526–015–0334–8.

Deidun A., Castriota L., Falautano M., Maraventano G., Prazzi E., Andaloro F., 2015. Documenting the occurrence of the Lessepsian fish *Stephanolepis diaspros* within the Strait of Sicily, central Mediterranean. J. Black Sea/Mediterranean Environment, 21(1): 1–11.

Ferrario J., d'Hondt J.-L., Marchini A., Occhipinti-Ambrogi A., 2015. From the Pacific Ocean to the Mediterranean Sea: *Watersipora arcuata*, a new non-indigenous bryozoan in Europe, Mar. Biol. Res., 11(9): 909–919

Fiorin R, Riccato F., Colla S., Franzoi P., Costantini U., 2013. Biodiversità della Laguna di Venezia e della costa nord adriatica veneta. Segnalazioni (221). Boll. Mus. St. Nat. Venezia, 64: 144–145.

Guidetti P., Causio S., Licchelli C., 2012. The first record of *Enchelycore anatina* (Murenidae: Pisces) in the Ionian Sea (Mediterranean basin). Marine Biodiversity Records, 5: e22. Doi:10.1017/S1755267212000164.

Langeneck J., Barbieri M., Maltagliati F., Castelli A., 2015. The low basin of the Arno River (Tuscany, Italy) as alien species hotspot: first data about *Rhithropanopeus harrisii* (Crustacea, Panopeidae). Transit. Waters Bull., 9(1): 1–10.

Langeneck J., Boyer M., De Cecco P.G, Luciani C., Marcelli M., Vacchi M., 2015. First record of *Acanthurus chirurgus* (Perciformes: Acanthuridae) in the Mediterranean Sea, with some distributional notes on Mediterranean Acanthuridae. Medit. Mar. Sci., 16(2): 427–431.

Lee T., Shin S., 2014. Morphological and molecular identification of an introduced alien sea squirt (Tunicata: Ascidiacea) in Korea. Proceedings of the Biological Society of Washington, 127(1): 284–297.

Lezzi M., Pierri C., Cardone F., 2015. Presence of *Celleporaria brunnea* (Bryozoa: Lepraliellidae) in the Central Mediterranean: first occurrence in the Gulf of Taranto. Marine Biodiversity Records, 8, e137.

Lodola A, Ferrario J., Occhipinti-Ambrogi A., 2015. Further Mediterranean expansion of the non-indigenous bryozoan *Celleporaria brunnea*: multiple records along the Italian coasts. Scientia Marina 79(2): 263–274.

Lorenti M., Keppel E., Petrocelli A., Sigovini M., Tagliapietra D., 2015. The non-indigenous *Paranthura japonica* Richardson, 1909 (Isopoda: Anthuroidea: Paranthuridae) from the Mar Piccolo lagoon, Taranto (Italy, Mediterranean Sea). Environ. Sci. Pollut. Res. DOI 10.1007/s11356–015–4994–5.

Maltagliati F., L. Lupia, A. Castelli, F., Pannacciulli G., 2015. The genetic structure of the exotic ascidian *Styela plicata* (Tunicata) from Italian ports, with a reappraisal of its worldwide genetic pattern: Mar. Ecol. 1–11. Doi: 10.1111/maec.12261.

Manfrin C., Turolla E., Sook Chung J., Giulianini P.G., 2015. First occurrence of *Callinectes sapidus* (Rathbun, 1896) within the Sacca di Goro (Italy) and surroundings. Check List, 11(3): 1640, doi: http://dx.doi.org/10.15560/11.3.1640

Mannino A.M., Balistreri P., Iaciofano D., Galil B.S., Lo Brutto S., 2015. An additional record of *Kyphosus vaigiensis* (Quoy & Gaimard, 1825) (Osteichthyes, Kyphosidae) from Sicily clarifies the confused situation of the Mediterranean kyphosids. Zootaxa, 3963(1): 45–54.

Marchini A., Ferrario J., Nasi E., Occhipinti-Ambrogi A., 2015a. *Grandidierella japonica* Stephensen, 1938 has appeared in a Mediterranean marina (Tuscany, Italy): first signals of invasion? 16th ICA – International Colloquium on Amphipoda; Aveiro, Portugal 7–11 Sept 2015 (Abstract book).

Marchini A., Ferrario J., Sfriso A., Occhipinti-Ambrogi A., 2015b. Current status and trends of biological invasions in the Lagoon of Venice, a hotspot of marine NIS introductions in the Mediterranean Sea. Biol. Invasions, 17 (10): 2943–2962 . DOI: 10.1007/s10530–015–0922–3

Marchini A., Galil B.S., Occhipinti-Ambrogi A., 2015c. Recommendations on standardizing lists of marine alien species: Lessons from the Mediterranean Sea. Mar. Pollut. Bull., 101: 267–273.

Montefalcone M., Morri C., Parravicini V., Bianchi C.N., 2015. A tale of two invaders: divergent spreading kinetics of the alien green algae *Caulerpa taxifolia* and *Caulerpa cylindracea*. Biol Invasions, 17: 2717–2728.

Munari C., Bocchi N., Mistri M., 2015. Epifauna associated to the introduced *Gracilaria vermiculophylla* (Rhodophyta; Florideophyceae: Gracilariales) and comparison with the native *Ulva rigida* (Chlorophyta; Ulvophyceae: Ulvales) in an Adriatic lagoon, Ital. J. Zool., DOI: 10.1080/11250003.2015.1020349.

Musco L., Andaloro F., D'Anna G., Giangrande A., Lo Brutto S., Mikac B., Mirto S., Pipitone C., Scuderi D., Vega Fernández T., Badalamenti F., 2015. Impatto di *Caulerpa taxifolia* var. *distichophylla* su macro- e meiofauna associate a *Posidonia oceanica*. Biol. Mar. Mediterr., 22(1): 136–137.

Occhipinti-Ambrogi A., Marchini A., Cantone G., Castelli A., Chimenz C., Cormaci M., Froglia C., Furnari G., Gambi M.C., Giaccone G., Giangrande A., Gravili C., Mastrototaro F., Mazziotti C., Orsi-Relini L., Piraino S, 2011. Alien species along the Italian coasts: an overview. Biol. Invasions, 13: 215–237.

Monteraele Gavazzi G., Sigovini M. Guarneri I., Tagliapietra D., 2015. *Bursatella leachii* de Blainville, 1817: sighting of uncommon alien species in the Lagoon of Venice. Boll. Mus. St. Nat. Venezia, 66: 111–115.

Parisi M.G., Vizzini A., Toubiana M., Sarà G., Cammarata M., 2015. Identification, cloning and environmental factors modulation of a αβ defensin from the Lessepsian invasive mussel *Brachidontes pharaonis* (Bivalvia: Mytilidae). Invertebr. Surviv. J., 12: 264–273.

Parravicini V., Mangialajo L., Mousseau L., Peirano A., Morri C., Montefalcone M., Francour P., Kulbicki M., Bianchi C.N., 2015. Climate change and warm-water species at the northwestern boundary of the Mediterranean Sea. Mar. Ecol., 36: 897–909.

Petrocelli A., Cecere E., Portacci G., Micheli C., De Cecco L., Martini S., Borfecchia F., 2015. Preliminary mapping of the alien seaweed *Hypnea cornuta* (Rhodophyta, Gigartinales) in the Mar Piccolo of Taranto (Southern Italy, Mediterranean Sea). Biol. Mar. Mediterr., 22(1): 44–45.

Piazzi L., Gennaro P., Ceccherelli G., 2015. Suitability of the ALien Biotic IndEX (ALEX) for assessing invasion of macroalgae across different Mediterranean habitats. Mar. Pollut. Bull., http://dx.doi.org/10.1016/j.marpolbul.2015.06.011.

Portelli P., Agius D., Mifsud C., Deidun A., 2015. Yet another Lessepsian arrival: first record of the euryleptid flatworm *Maritigrella fuscopunctata* from the Mediterranean Sea. In: Crocetta *et al.* New Mediterranean Biodiversity Records (October 2015). Medit. Mar. Sci., 16(3): 689.

Relini M., Torchia G., 1992. Prima segnalazione di *Caulerpa taxifolia* (Vahl) C. Agardh in acque italiane. Doriana (Suppl. Annuali Museo Civico di Storia Naturale 'G. Doria' di Genova), 6 (279): 1–4.

Rinaldi A. 2012. Atlante della fauna e flora marina dell'Adriatico nord-occidentale. La Mandragola Editrice, Imola, 640 pp.

Sanna D., Scarpa F., Lai T., Cossu P., Falautano M., Castriota L., Andaloro F., Francalacci P., Curini-Galletti M., Casu M., 2015. *Fistularia commersonii* (Teleostea: Fistulariidae): walking through the Lessepsian paradox of mitochondrial DNA, Ital. J. Zool., 82(4): 499–512.

Sperone E., Giglio G., Abate M., Giglio S., Madeo E., Giglio A., Golia S., Sangermano I., Mauro G., Circosta V., Aceto M., Forestieri F., Tripepi S., 2015. Contribution to the knowledge of the animal xenodiversity along Calabrian coasts (southern Italy, central Mediterranean). Acta Adriat., 56(2): 245–258.

Tiberti L., Barbieri F., Gambi M.C., 2015. Osservazioni sulla presenza di specie aliene lungo le coste della Campania: un esempio di conoscenza ecologica locale e "cittadinanza scientifica". Notiziario SIBM, 67: 23–29 (http://www.sibm.it/).

Trainito E., Doneddu M., 2015. Contribution to the knowledge of the molluscan fauna in the Marine Protected Area Tavolara-Punta Coda Cavallo: Ordo Nudibranchia. Boll. Malacol., 51(2): 54–70.

Papers quoted *in press* in the last National paper

Lodola A., Ferrario J., Occhipinti-Ambrogi A, 2015. Further Mediterranean expansion of the non-indigenous bryozoan *Celleporaria brunnea*: multiple records along the Italian coasts. Scientia Marina, 79(2): 263–274.

Stasolla G., Innocenti G., 2014. New records of the invasive crabs *Callinectes sapidus* Rathbun, 1896 and *Percnon gibbesi* (H. Milne Edwards, 1853) along the Italian coasts. BioInvasions Records, 3(1): 39–43.

Lithuania

Prepared by Sergej Olenin

Overview

In total, 31 NIS and two crypogenic species are registered in the Lithuanian waters of the Baltic Sea and the Curonian Lagoon, of them 22 are established and maintain self-sustaining populations, 10 are not established and for one the population status is unknown. All new introductions (since 2004) are secondary ones, i.e. species entered the Baltic Sea via other countries and then spread to the Lithuanian waters either by human-mediated pathways or by natural means.

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

A project on preparation of national documents aimed at ratification of the IMO Ballast Water Management Convention (funded by the Environmental Protection Agency of Lithuania) was completed. Deliverables of the project included: 1) a review of national, foreign (especially from the Baltic Sea region) and international legislative acts related to the ballast water management; 2) the rules for ships calling to LT waters in relation to BWMC; 3) cooperation scheme between LT institutions involved in ballast water management control, defining their responsibilities and principles of interaction; 4) a report on the risk assessment of NIS introductions to LT waters with ship ballast water.

2. Intentional introductions

No new intentional introductions.

3. Unintentional introductions

New unintentional introductions were not found. In addition to routine biological monitoring (phytoplankton, zooplankton, zoobenthos, early stages of fish, commercial fish surveys) in the Lithuanian parts the Baltic Sea and the Curonian Lagoon a specialized Port Baseline Biological Survey (PBBS) was performed in the port of Klaipėda based on HELCOM (2013) protocol.

4. Pathogens

During the PBBS in the port of Klaipėda the presence of human pathogens (intestinal enterococci, *Escherichia coli, Vibrio cholerae*) in water samples was not confirmed.

5. Meetings and projects

Meetings

- The 10th Baltic Sea Science Congress, June 2015, Riga, Latvia. Presentations:
  - Anastasija Zaiko, Aurelija Samuilovienė, Alba Ardura, Eva Garcia-Vazquez, Xavier Pochon, Susanna Wood: "Molecular approaches for non-indigenous species surveillance – from introduction pathways to established populations".
  - Andrius Šiaulys: "Ecological niche modelling of non-indigenous spionid *Marenzelleria sp.* in the SE Baltic Sea".
  - Aistė Stulpelytė, Andrius Šiaulys: "Major decline of blue mussel *Mytilus sp.* population in coastal Lithuanian Baltic Sea" [a paper showing the impact of the round goby *Neogobius melanostomus*].
- Workshop on Enlarging the European Alien Species Information Network, 6–7 October 2015, Joint Research Center, Ispra, Italy
  - Sergej Olenin. AquaNIS: a new generation information system on aquatic non-indigenous and cryptogenic species.
- Scientific symposium "Tools for assessing status of European aquatic ecosystems", May 6–7, 2015, Malmö, Sweden
  - Sergej Olenin, Dan Minchin, Anastasija Zaiko. Assessing uncertainty of indicators: aquatic invasive species and environmental status of waterbodies.

Projects:

- FP7 VECTORS. Vectors of Change in Oceans and Seas Marine Life, Impact on Economic Sectors (2011–2015). The main outcome: AquaNIS, an information system on aquatic non-indigenous and cryptogenic species. The Lithuanian team has commitment to maintain this system after the project is over (January 2015).
- FP7 DEVOTES. Development of innovative tools for understanding marine biodiversity and assessing good environmental status (2012–2016). The Lithuanian team is involved in in development of NIS indicators.
- BONUS BIO-C3. Biodiversity changed investigating causes, consequences and management implications. PI for Lithuania: Dr. A. Zaiko <anastasija.zaiko@jmtc.ku.lt>
- BALMAN – Joint Lithuania-Latvia-Taiwan cooperation fund project "Development of the ships' ballast water management system to reduce biological invasions".
- Project on implementation of the IMO Ballast Water Management Convention in Lithuania.

6. References and bibliography

Information systems

AquaNIS, 2016. Information system on aquatic non-indigenous and cryptogenic species <www.aquanis.ku.lt> Contains data on NIS and CS biological and other traits (including association with shipping vectors and availability of molecular data), salinity and temperature tolerance limits, introduction events in countries and country-regions in European regional seas, Northwest Pacific Ocean, New Zealand and Canadian Arctic.

Publications (since the 2015 national report)

Ardura A., Zaiko A., Borrell Y.J., Samuiloviene A., Garcia-Vazquez E. 2016. Novel tools for early detection of a global aquatic invasive, the zebra mussel *Dreissena polymorpha*. Aquatic Conservation, in press.

Ardura A., Zaiko A., Martinez J.L., Samuiloviene A., Borrell Y., Garcia-Vazquez E. 2015. Environmental DNA evidence of transfer of North Sea molluscs across tropical waters through ballast water. Journal of Molluscan Studies, 1–7, doi:10.1093/mollus/eyv022

Ardura A., Zaiko A., Martinez J.L., Samuiloviene A., Semenova A., Garcia-Vazquez E. 2015. eDNA and specific primers for early detection of invasive species- a case study on the bivalve *Rangia cuneata*, currently spreading in Europe. Marine Environmental Research, 112(B): 48–55.

Olenin, S., Ojaveer, H., Minchin, D., Boelens, R. 2016. Assessing exemptions under the ballast water management convention: preclude the Trojan horse. Marine Pollution Bulletin, 103, 84–92

Paldaviciene A., Zaiko A., Mazur-Marzec H., Razinkovas-Baziukas A. 2014. Bioaccumulation of microcystins in invasive bivalves: a case study from the boreal lagoon ecosystem. Oceanologia 57(1): 93–101

Skabeikis A., Lesutienė J., 2015. Feeding activity and diet composition of round goby (*Neogobius melanostomus*, Pallas 1814) in the coastal waters of SE Baltic Sea. Oceanological and Hydrobiological Studies, 44(4): 508–519.

Zaiko A., Daunys D. 2015. Invasive ecosystem engineers and biotic indices: giving a wrong impression of water quality improvement? Ecological Indicators 52: 292–299.

Zaiko A., Martinez J.L, Ardura A., Clusa A., Borrell Y.J., Samuiloviene A., Roca A., Garcia-Vazquez E. 2015. Detecting nuisance species using NGST: Methodology shortcomings and possible application in ballast water monitoring. Marine Environmental Research, 112: 64–72

Zaiko A., Martinez J.L., Schmidt-Petersen J., Ribicic D., Samuloviene A., Garcia-Vazquez E. 2015. Metabarcoding approach for the ballast water surveillance - an advantageous solution or an awkward challenge? Marine Pollution Bulletin 92: 25–34.

Zaiko A., Samulioviene A., Ardura A., Garcia-Vazquez E. 2015. Metabarcoding approach for non-indigenous species surveillance in marine coastal waters. Marine Pollution Bulletin, 100:53–59.

Norway

Prepared by Anders Jelmert, with contributions from Jan Sundet, Ann Lisbeth Agnalt, Torjan Bodvin and Vivian Husa, IMR

Summary:

- No further genetic clarification of the origin of the snowcrab *Chionoecetes opilio.* It has previously been established that there is a significant genetic distance between the Barents Sea, and the Canada/Greenland stocks). The snow crab continues to expand its range and population density in the Barents Sea. Specimen were caught in the W. part of the Kara Sea, but not in the eastern part (hence likely from the Barents Sea Stock). Slight increase in king crab *Paralithodes camtschaticus* stock from 2015, both catchable males and total numbers. The culling fishery (no quotas) W. of E 26° still seems to slow down (but not prevent) further SW migration and population growth.
- Two records of American lobster in Norway in 2015. Both from the area W and SW of Bergen. One berried female (*Homarus americanus* ♀ x *H. homarus* ♂). The eggs will be hatched at a quarantine-facility to monitor hatching success and survival.
- A survey on the western coast of Norway by bryozoan taxonomic experts revealed presence of two alien species: *Tricellaria inopinata* and *Schizoporella japonica.* (On the Western coast between Bergen and Trondheim)
- While the Norwegian Biodiversity Information Centre still is the official Norwegian repository for information on Red-listed and Black-listed species (including NIS), a NIS expert group (to give advice on management) is established at "The Norwegian Scientific Committee for Food Safety". (see www.english.vkm.no)

1. Regulations: Law of biodiversity. Finalised 2011 and 2012

- Chapter IV on Alien species
- General prohibition against releasing NIS, unless special permit is granted after RA.
- No new changes in 2015

While the Norwegian Biodiversity Information Centre still is the official Norwegian repository for information on Red-listed and Black-listed species (including NIS), a NIS expert group (to give advice on management) is established at "The Norwegian Scientific Committee for Food Safety").

2. Intentional:

No new alien species (*proper)* intentionally being introduced has been reported. There is quite widespread translocation (within Norwegian borders) of several wrasse species in the aquaculture industry (employed for biological de-lousing of salmon). A risk evaluation for the Aquaculture Industry was finalized in 2014 and published in 2015 (unfortunately only in Norwegian only)

3. Unintentional:

New sightings

Two new NIS Bryozoans were reported in 2015 *Tricellaria inopinata* and *Schizoporalla japonica*. (Porter *et al.*, 2015).

General information:

Two new specimen of *H. americanus* have been detected in 2015. Both caught in the area W and SW of Bergen at Approx. 69 and 68.5° N

The specimen will be kept in quarantine conditions until hatching of eggs to evaluate survival and eventual fertility.

Contact: Ann-Lisbet Agnalt, IMR Ann-lisbeth.agnalt@imr.no

Since 2000, a total of 30 American lobsters have been confirmed in Norway, 24 in Sweden, one in Denmark, and three in Ireland .

Previous Sightings

Range expansions:

Several new observation of range expansion for *Gracilaria vermiculophylla, Styela clava* and *C. gigas* have been recorded (Vivian Husa, IMR and A. Jelmert, IMR)

Mnemiopsis leidyi has reappeared along the coast. Higher numbers close to the shore, lower densities offshore.

Snow Crab: *Chionoecetes opilio.* First observed in Russian sector 1996, 2004 in Norw. EEZ. Still expands geographical distribution and stock is increasing both in Norwegian and Russian EEZ (Figure 1). In addition to continued northward and eastward range expansion, several specimen were caught E of Novaja Zemlja (Kara Sea proper).

Prefer colder water (typ 3–4 C) than red king crab. N & E distribution, may even retract if the Arctic gets warmer. SSB for Snow crab now > 10 times the SSB for king crab. In 2015, a growing fishery with both Norwegian and Russian vessels have taken place. Is now found on the west coast of Svalbard. Contact. Jan.h.sundet@imr.no

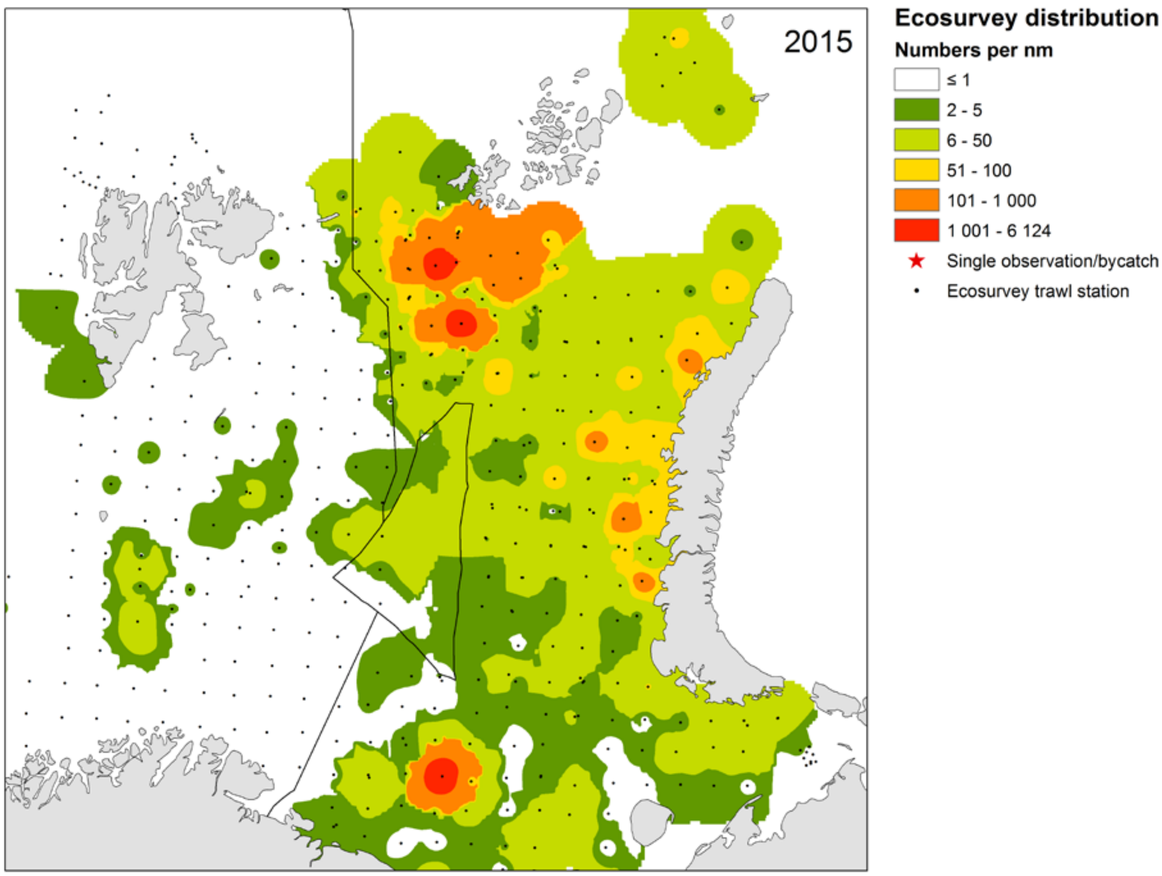
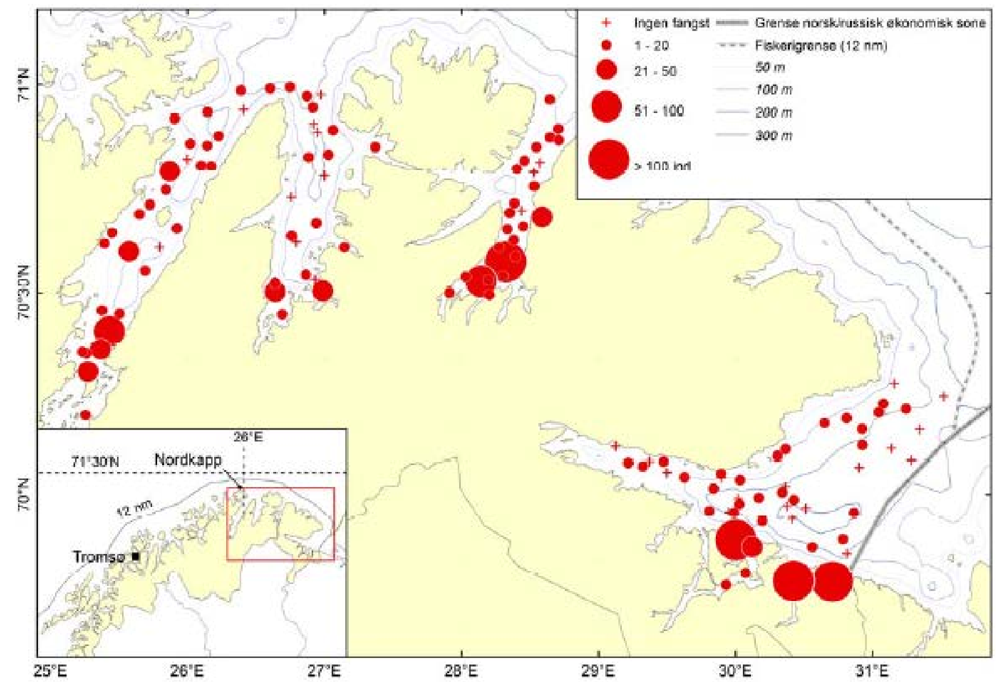


Figure 1. Distribution and density (numbers / nm trawl haul) in 2015 (J.H. Sundet, unpubl.).

Red King Crab (Paralithodes camtschaticus)

Stock size of catchable males (CL>130 mm) has increased the later years, and stock net production is ABOVE level for MSY (Maximum Sustainable Yield) See results for trawl survey, Figure 2. Higher quotas to increase F (Fishing mortality) is recommended in 2016 and 2017. Suggested Quota Sep1 – Dec31, 2016: no more than 1740 tonnes 2017, < 2000 tonnes. Only males with CL above 130 mm can be harvested legally. (Sundet *et al.*, 2016)



Figur 2. Krabbetrålstasjoner og fangstmengde av kongekrabbe i fjordene i det kvoteregulerte området høsten 2015.

Figure 2. Trawling stations and catch volume of King crab in the quota regulated area in NEEZ. Dot size/numbers represent amount of catchable males pr nautical mile trawled (Sundet *et al.* 2016).

While the free culling fishery W. of 26 E Seems to reduce the S + SW spread of the king crab, a slight increase in numbers, but moderate SW range expansion was observed in the pot fishing survey from 2014–2015, Figures xx+1 and xx+2

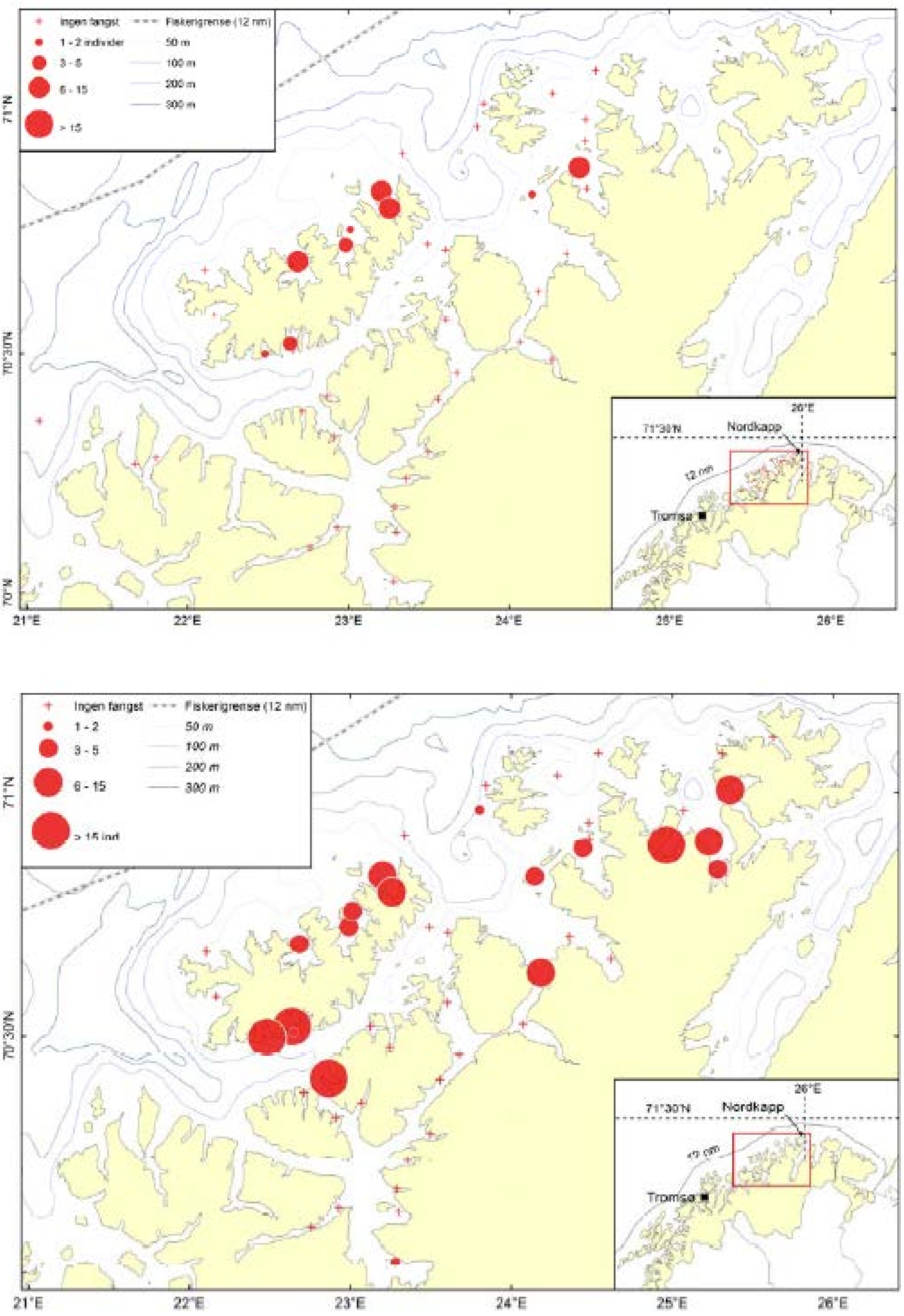


Figure 3 a,b. Number of *P. camtschaticus* per pot in fishery, 2014 (above) and 2015 (below).

Eradication programmes:

Crassostrea gigas: eradication as part of action plan for one municipality (Oslo and Akershus). Not formally, but *de facto* in some areas in Arendal municipality.

During 2014, a scientific advice for management of *C. gigas* (including commercial exploitation has been produced (Bodvin, *et al.*, 2014).

Several counties in SE part of Norway consider management by a combination of commercial harvest and site selective culling (in areas of great biological value, or e.g. public beaches).

Homarus americanus*:* Not formally established or regularily funded (!),

but suspect specimen are collected by fishermen and are still genetically analysed at IMR. Since 2000, 30 specimen of American lobsters have been found in Norway, 24 in Sweden, 1 i Denmark and 3 in Ireland. All have been verified as *H. americanus* by DNA analysis at IMR, Norway.

In 2015, two suspect specimen were analysed, both *H. americanus*. One of these was a berried female, and the eggs were confirmed by DNA analysis to be a *Homarus americanus* ♀ x H. homarus ♂.

Not Seen (or not confirmed) Species Yet:

One sample of suspected *Didemnum vexillum* was collected in rapid coastal surveys (Agder counties (58 59N, 11 4E, to 59 0N, 9 5E). Contact: V. Husa, IMR. Vivian.husa@imr.no

Import and exports:

Table 1. Export of Red king crab, 2014 6 2015, not frozen. A substantial part of export to e.g. S. Korea is live specimen (males only).

Year		2014		2015	
Measures		Value 1000 NOK	Amount (tonnes)	Value 1000 NOK	Amount (tonnes)
	Country name				
Total		119 023	699	148 103	756
King Crab Not frozen, males only		119 023	699	137 768	636
	China	3 741	19	1 092	4
	South Korea	90 137	562	90 567	462
	Japan	.	.	259	2
	UAE	1 289	5	1 670	5
	Hongkong	.	.	455	2
	Singapore	.	.	40	0
	Taiwan	432	2	2 209	7
	Vietnam	14	0	.	.
	Belgium	635	3	1 503	5

	Denmark	222	1	1 129	7
	Finland	184	1	68	0
	France	308	1	220	1
	Italy	6 343	29	8 380	31
	Netherlands	330	1	1 419	5
	Poland	2	0	.	.
	Spain	.	.	40	0
	UK	4 235	23	5 403	25
	Sweden	232	1	452	3
	Germany	564	3	469	2
	Russland	4 548	21	.	.
	Tyrkia	889	3	612	2
	Ukraina	475	2	240	1
	Canada	26	0	5 059	19
	USA	4 417	21	16 481	53

Table 2. Export (value and amount) of "non-frozen snow crab".

Year		**2014**		**2015**	
Measures		**Value 1000 NOK**	**Amount (tonnes)**	**Value 1000 NOK**	**Amount (tonnes)**
Snowcrab, not frozen		.	.	10 335	120
	Sør-Korea	.	.	159	3
	Japan	.	.	1 169	17
	Philiphines	.	.	7	0
	Hongkong	.	.	174	2
	Spain	.	.	1	0
	UK	.	.	8	0
	USA	.	.	8 818	99

Note that the data on export does not specify in the "non-frozen" really is alive.

4. Pathogens

No severe Ostreid Herpes-virus μVar reported for *Crassostrea gigas* or other mussels in 2015.

5. Meetings

6. References and bibliography

Bodvin, T., Albretsen, J., Jelmert, A., Strand, Å., Moy, F., Dolmer, P. and Mortensen, S. 2015. Growth, reproduction and recruitment of the pacific oyster (*Crassostrea gigas*) in an invasion front. *Oral presentation at50th EMBS,* Helgoland, Germany, September 21–25, 2015

Bodvin, T., Rinde, E. and Mortensen, S. 2014

Faggrunnlag stillehavsøsters (Crassostrea gigas).

(Basic knowledge about pacific oyster (Crassostrea gigas) (In Norwegian w./short English summary).

http://www.miljodirektoratet.no/Documents/publikasjoner/M304/M304.pdf

Dolmer, P, Holm, MW, Strand, Å, Lindegarth, S, Bodvin, T & Mortensen S. 2014 The invasive Pacific oyster, *Crassostrea gigas*, in Scandinavian coastal waters: a risk assessment on the impact in different habitats and climate conditions. Fisken og Havet nr 2 2014. 67s.

Fuhrmann, M.M., Pedersen, T., Ramasco, V., and Nilssen, E.M., 2015. Macrobenthic biomass and production in a heterogenic subarctic fjord after invasion by the red king crab. Journal of Sea Research, 106: 1–13. - See more at: https://uit.no/om/enhet/ansatte/person?p_document_id=41352&p_dimension_id=88163#sthash.6lVHfzDZ.dpuf

Hjelset, Ann Merete; Nilssen, Einar Magnus; Sundet, Jan Henry. Reduced size composition and fecundity related to fishery and invasion history in the introduced red king crab (Paralithodes camtschaticus) in Norwegian waters. Fisheries Research 2012; Volum 121. ISSN 0165–7836.s 73 - 80.s doi: 10.1016/j.fishres.2012.01.010.

Jørgensen L.L., and Spiridonov V., 2013. Effect from the king- and snow crab on Barents Sea benthos. Results and conclusions from the Norwegian-Russian Workshop in Tromsø 2010. Fisken og Havet nr. 8/2013. Institute of Marine Research, Bergen, Norway, 41 pp.

https://www.imr.no/filarkiv/2013/10/fh_8–2013_kongekrabbe_siste.pdf/nb-no

Mortensen, S., Bodvin, T., Skår, C.K., Sælemyr,L., Jelmert, A., Albretsen, J. og Naustvoll, L-J. 2014. Massedød av stillehavsøsters, Crassostrea gigas, i Sverige og Norge, september 2014. Rapport fra Havforskningsinstituttet. Nr 28–2014. 12 p. (In Norwegian).

Mortensen S, Strand Å, Bodvin T, Alfjorden A, Skår CK, Jelmert A, Aspán A, Sælemyr L, Naustvoll LJ, Albretsen J (2016). Summer mortalities and detection of ostreid herpesvirus microvariant in Pacific oyster Crassostrea gigas in Sweden and Norway. Diseases of Aquatic Organisms 117:171–176.

Sundet, J.H., Hvingel, C., and Hjelset, A.M., 2015 Kongekrabbe i norsk sone

Bestandstaksering og rådgivning 2015 (King crab in Norwegian EEZ. Stock asessment and advice, 2016 IMR report, (In Norwegian only).

Ware, C., Berge, J., Sundet, J.H., Kirkpatrick, J.B., Coutts, A.D.M., Jelmert, A., Olsen, S.M., Floerl, O. and Alsos, I.G. 2013. Climate change, non-indigenous species and shipping: assessing the risk of species introduction to a high-Arctic archipelago. Diversity and Distributions, (Diversity Distrib.) (2013) 1–10 DOI: 10.1111/ddi.12117, http://wileyonlinelibrary.com/journal/ddi

Ware, C., Berge, J., Jelmert, A., Olsen, S. M., Pellissier, L., Wisz, M., Kriticos, D., Semenov, G., Kwaśniewski, S., Alsos, I. G. (2015), Biological introduction risks from shipping in a warming Arctic. Journal of Applied Ecology. doi: 10.1111/1365–2664.12566

Poland

Prepared by Aldona Dobrzycka-Krahel and Anna Szaniawska

Overview

The quagga mussel (*Dreissena rostriformis bugensis* Andrusov, 1897) was recorded for the first time in the Szczecin Lagoon in 2014 (Woźniczka *et al.*, 2016). *Chara connivens* P. Salzmann ex A. Braun 1835 was rediscovered in the Vistula Lagoon in 2011, almost 35 years after its last record. In 2012 the species was recorded for the first time in the Szczecin Lagoon (Brzeska *et al.*, 2015). It is an extremely rare and protected species in Polish brackish waters. *Rangia cuneata* (Mactridae) established in the Polish part of the Vistula Lagoon (Warzocha *et al.*, 2015). The species, first recorded in the Lagoon in 2010, has rapidly colonized almost the entire basin. *Dikerogammarus villosus* (Sowinsky, 1894) was recorded for the first time in the Polish part of the Baltic Sea basin: the Śmiała Vistula and the Vistula Lagoon (Dobrzycka-Krahel *et al.*, 2015). *Pacifastacus leniusculus* (Dana, 1852) were found in the Wieprza (southern Baltic coastal river) and its two tributaries (Dobrzycka-Krahel *et al.*, 2015).

1. Regulations: An update on new regulations and policies (including aquaculture and vector management)

Poland has started preparations for the IMO BWMC ratification what is expected in 2016.

In December 2015 Polish Parliament passed an amendment to the water law, which implements the EU Marine Strategy Framework Directive.

In the years 2015–2018 the pilot study on biodiversity and marine habitats will be conducted under coordination of General Environmental Protection Inspectorate. NIS monitoring in three Polish ports: Świnoujście, Gdańsk and Gdynia is included.

2. Intentional

In 2015 deliberate releases of salmon *Salmo salar*, sea trout *Salmo trutta*, whitefish *Coregonus maraena*, Atlantic sturgeon *Acipenser oxyrinchus* and European eel *Anguilla anguilla* were conducted (information from Inland Sea Fisheries Institute in Olsztyn).

3. Unintentional:

Dreissena rostriformis bugensis (Andrusov, 1897) was recorded for the first time in the Szczecin Lagoon (Odra River estuary, southern Baltic Sea) in 2014 (Woźniczka *et al.*, 2016). The quagga mussel is another Ponto-Caspian dreissenid bivalve. The individuals first identified as representing *D. rostriformis bugensis* were collected on 10 October 2014 in the northern part of the Szczecin Lagoon. They co-occurred with the zebra mussel *D.*

polymorpha to form mixed aggregations. The following features of *D. rostriformis bugensis* are diagnostic: the shell triangular in outline, distal part of the shell rounded, a rounded triangular carina between the ventral and dorsal surface, ventral side of the shell convex, without any sharp ventro-lateral ridge, dorsal side flat, also with a rounded margin, frequently with an ala-like distension, the two shells distinctly asymmetric, the proximal part of the right shell curved mid-ventrally, umbone (the thickest and oldest part of the shell) pointed and directly downward, byssus grove on the lower part of the shell very fine, located close to the hinge, periostracum variously coloured (from light brown-yellow to totally black) with dark concentric rings variously shaped and sized and lighter-coloured rings found close to the hinge, shells of some individuals may differ in colouration of the latero-ventral and latero-dorsal side. The apical septum is located inside the proximal part of the shell, it serves as a myophore plate (an attachment site) for the anterior pedal retractor and the anterior shell adductor. The dorsal margin features two elongated scars left by the posterior adductor and posterior byssal retractor. In the proximal part, the shells are connected with the ligament. The hinge teeth are residual.

D. rostriformis bugensis is the bivalve which began expanding its range in Eastern Europe as late as post 1940, when the first dam reservoirs were built on the Dnieper River. At present, the quagga is observed to be spreading rapidly in inland waters of Western Europe (Karatayev *et al.*, 2015, Matthews *et al.*, 2014). The vectors and mechanisms of the quagga mussel immigration into the Baltic Sea catchment are not known. Probable quagga mussel is spreading from the sites it currently occupies in Western Europe (Heiler *et al.*, 2013, Matthews *et al.*, 2014).

Chara connivens P. Salzmann ex A. Braun 1835 was rediscovered in the Vistula Lagoon in 2011, almost 35 years after its last record. In 2012 the species was recorded for the first time in the Szczecin Lagoon (Brzeska *et al.*, 2015). It is an extremely rare and protected species in Polish brackish waters. Charophytes are a group of macroscopic green algae. *C. connivens* is widely distributed, recorded in Europe, Africa and Northern Asia (Krause, 1997, Torn and Martin, 2003, Groves and Bullock-Webster, 1924, Wood and Imahori, 1965, Luther, 1979). Within Europe this species is recorded in the western European maritime regions, along the coast of the Mediterranean and the Baltic Sea, and in inland saline waters of central and southern Europe. In Poland it was recorded in the Gulf of Gdańsk (Dąbska, 1964) and the Vistula Lagoon (Pliński at al., 1978).

C. connivens is a small alga, usually up to 15 cm long, rarely longer (25–50 cm). It is very similar to those of *C. globularis* due to presence of triplostichous stem cortex with lacking or rudimentary spine cells and two rows of rudimentary stipulodes (Wood and Imahori 1965). The fact that *C. connivens* was rediscovered in the Vistula Lagoon (eutrophicated water), might have resulted from the natural ability of charophytes to survive in unfavorable environmental conditions.

Dikerogammarus villosus (Sowinsky, 1894) was recorded for the first time (May 2011) in the Polish part of the Baltic Sea basin: the Śmiała Vistula and the Vistula Lagoon (Dobrzycka-Krahel *et al.*, 2015). *D. villosus* is the species which constantly expanding its range of occurrence. Earlier it established in the Gulf of Gdańsk, where it was recorded for the first time in 2010 (Dobrzycka-Krahel and Rzemykowska, 2010).

This species is called the "killer shrimp" because of its extremely aggressive behavior towards other species.

In Poland *D. villosus* was first recorded in the Oder River in 1999 (Müller *et al.* 2001) and later in the Szczecin Lagoon and adjacent coastal waters in 2002–2004 (Gruszka *et al.*, 2003, Gruszka and Woźniczka, 2008). Later the species was discovered in the Bug River – in 2003 (Konopacka, 2004) and in the Vistula River – near Wyszogród in 2007 (Bącela *et al.*, 2008). Now this species expands its range of occurrence towards brackish water.

Pacifastacus leniusculus (Dana, 1852) is spreading towards the Polish coastal waters of the Baltic Sea (Dobrzycka-Krahel *et al.*, 2015). The signal crayfish *P. leniusculus* (Dana, 1852) is a native species to North America. In the 1960s it was introduced to Scandinavia (Fürst, 1977) and later to other European countries. *P. leniusculus* was also imported to Poland. First batch of crayfish was brought in 1972 (Kossakowski *et al.*, 1978) and the last one in 1992 (Śmietana, 2011). In spring and summer 2014, 127 *P. leniusculus* individuals were found in the Wieprza (southern Baltic coastal river) and its two tributaries. Earlier, the occurrence of *P. leniusculus* in the lower Wieprza (Darłowo) about 3 km from the Baltic Sea, was recorded in September 2012 by Heese (2013). The phenomenon of multi-point settlements of signal crayfish at the Wieprza River basin scale has not been known in Poland. The individuals of this species were found away from the known site of introduction in 1995 into the Wieprza River drainage area. The reason of such situation may be the fact that the signal crayfish can migrate from the farm and travel several miles across land (Groves, 1985), colonizing adjacent water bodies.

Now the signal crayfish is the most widespread alien crayfish in Europe (Kouba *et al.* 2014). It is flexible towards environmental factors, tolerates water salinities up to 21 PSU (Holdich *et al.*, 1997) and water temperatures reaching 33 °C (Rutledge and Pritchard, 1981). The signal crayfish is an omnivorous species, consuming plants, invertebrates, snails, small fish and fish eggs; it even cannibalizes its own young. But most of its diet consists of detritus (Mason, 1975, Momot *et al.*, 1978), which is very important component for both adults and juveniles (Whitledge and Rabeni, 1997, Bondar *et al.*, 2005). The species features beside a wide trophic spectrum, include vagrancy, aggresiveness, a high reproductive potential, a faster growth rate and a larger size than native crayfish (Holdich, 1988, Śmietana and Krzywosz, 2006).

Previous Sightings

Rangia cuneata (G. B. Sowerby I, 1832) established in the Polish part of the Vistula Lagoon (Warzocha *et al.*, 2015). The species, first recorded in the Lagoon in 2010, has rapidly colonized almost the entire basin.

R. cuneata is a species native to the Gulf of Mexico. In the 1960s, the species colonized coastal Atlantic waters to spread north up to the mouth of the Hudson River, New York (Pfitzenmeyer and Drobeck, 1964).

The occurrence of *R. cuneata* in the Polish part of the Vistula Lagoon in 2012–14 shows that the species – both juveniles and adults (from 2 to 48 mm), colonized the Vistula Lagoon. The absence of *R. cuneata* off river mouth could be explained by the low salinity which is too low for the survival of veliger larvae. *R. cuneata* can adapt to salinities varying from about 0 to 33 psu, but the young of the species have a much lower salinity tolerance than adults (Cooper, 1981, LaSalle and de la Cruz, 1985). In 2013, following winter, there were almost no *R. cuneata* present, because of oxygen deficiency under the ice. Results from 2012 show that the abundance and biomass of the species depend on depth and sediment type. Preliminary data collected in 2014 point the presence of *R. cuneata* (mainly young specimens: 0+ and 1+) throught almost the entire Polish part of the Lagoon (Warzocha *et al.*, 2015).

Rhithropanopeus harrisii (Gould, 1841). This species reached Europe by ship transport (Rodriguez and Suarez, 2001, Projecto-Garcia *et al.*, 2010) and was first described in the Netherlands (Maitland 1874). Thereafter, *R. harrisii* gradually spread into other European regions, including countries with Baltic coastlines, e.g. Germany (Nehring and Leuchs, 1999), Denmark (Jensen and Knudsen, 2005), Poland (Demel, 1953, Kujawa, 1957, Michalski, 1957) and most recently Estonia (Kotta and Ojaveer, 2012) and Finland (Fowler *et al.*, 2013). In Polish coastal waters, *R. harrisii* occurred in 1951 and since then, a stable and dense population has been observed in the Vistula Lagoon (Demel, 1953, Rychter, 1999) and Dead Vistula River (Michalski, 1957, Turoboyski, 1973, Normant *et al.*, 2004). However, in recent years, more frequent appearance as well as a sudden increase in the abundance of *R. harrisii* was noticed also in the Gulf of Gdańsk and its inner part, Puck Bay. The sudden appearance of *R. harrisii* in these waters is somewhat surprising because, as mentioned, for decades stable populations have occurred in the adjacent waters of Dead Vistula River and the Vistula Lagoon (Turoboyski 1973; Janta, 1996; Rychter, 1997, 1999; Normant *et al.*, 2004), and despite a direct connection with Dead Vistula River, *R. harrisii* was absent for more than 50 years in the Gulf of Gdańsk (Hegele-Drywa and Normant, 2014).

The genetic diversity of *R. harrisii* from four populations in the Polish coastal waters shows that *R. harrisii* from recently established populations in the Puck Bay and the Gulf of Gdańsk in the Polish coastal waters are genetically similar to the older Polish populations in the Dead Vistula River and the Vistula Lagoon and thus probably colonized from the older population (Hegele-Drywa *et al.*, 2015). The obtained results also show that small-scale geographic isolation of the newly established populations as well as larval retention mechanisms of this species may effect on some differences of local genetic diversity.

In ***Neogobius melanostomus*** (Pallas, 1814) the presence of intersex was reported (Guellard *et al.* 2014). The intersex is an anomaly defined as a simultaneous occurrence of both male and female gonad tissue within the same individual of a gonochoristic species. The round goby *N. melanostomus* is a batch spawning gonochorist native to the Ponto-Caspian region. The first *N. melanostomus* in the Baltic Sea was found near the Hel harbor (Gulf of Gdańsk) in 1990 (Skóra and Stolarski, 1993). Since then this invasive bottom-dwelling fish has become one the most abundant species in the Gulf of Gdańsk and has spread to other regions of the basaltic Sea (Sapota, 2012). Fish were collected at two stations of the shallow waters of the Gulf of Gdansk: one located in Gdynia harbour and second in the vicinity of Hel harbour. The phenomenon of intersex was identified in single individuals in each group of *N. melanostomus* sampled at both stations. Intersex individuals constituted 5.9 % at Gdynia and from 6.7 to 7.7 % of males at Hel station.

The Gulf of Gdańsk is one of the most anthropogenically affected Polish Baltic Sea coastal areas, due the activity of various industries, municipal discharges and inflows from polluted rivers (Andrulewicz and Witek, 2002, HELCOM 2010).

4. Pathogens

No new sightings.

5. Meetings

Past year

Warsaw Days of Aquarium, 22–23.05.2015, Poland

II Warsaw Days of Aquarium was the conference in Poland, where there were lectures supported by scientific research and achievements of Polish aquarists.

The theme of the conference was widely understood aquarium. There were lectures on fish, shrimps, crayfish, aquatic plants, water chemistry, lighting and undesirable impact on the aquarium environment (invasive alien species of Poland and Europe).

Joint HELCOM/OSPAR Task Group on Ballast Water Management Convention exemptions (HELCOM /OSPAR TG BALLAST), Sixth meeting Gdansk, 16–17 September 2015, Poland

The Meeting was hosted by Polish Ministry of Infrastructure and Development. Among participants were delegates from Belgium, Denmark, Finland, Germany, Ireland, Lithuania, the Netherlands, Norway, Poland, Spain and Sweden and observers from the European Community Shipowners' Association (ECSA) and the Great Lakes Commission. Updates to the Joint HELCOM/OSPAR Harmonised Procedure on the Granting of BMW Convention Exemptions including port sampling procedures, on-line decision support tool and target species were the main objectives of the meeting.

Meetings (list of presentations):

Becker B., Normant M., Hellmann C., Worischka S., Koop J.H.E., Winkelmann C. The physiological response of *Dikerogammarus villosus* and *Gammarus roeselii* to different food quality. 9th Symposium for European Freshwater Sciences, 5–10 July 2015 Geneva, Switzerland, str. 175

Dobrzycka-Krahel A., Skóra M. E., Raczyński M., Szaniawska A., 2015. Signal crayfish *Pacifastacus leniusculus* (Dana, 1852) (Crustacea: Decapoda) – the highly invasive species enters the Polish coastal waters of the Baltic Sea. 10th Baltic Sea Science Congress: "Science and innovation for future of the Baltic and the European regional seas", 15–19 June Riga, Latvia, 2015, 177.

Janas U., Brzana R., Tutak B., Kendzierska H., Dąbrowska A.H., 2015. The most recent records of benthic non-indigenous species in the Polish coastal waters. 10th Baltic Sea Science Congress: "Science and innovation for future of the Baltic and the European regional seas", 15–19 June Riga, Latvia, 2015, 216.

Krzyżanowska K., Kunkel P., Marszewska L., Normant M., 2015. Diversity of fouling and associated organisms in anthropogenic habitat - Port of Gdynia case study. IV Konferencja Młodych Naukowców z okazji Światowego Dnia Wody, 12–13 marca 2015, Poznań.

Marszewska L., Normant M., Krzyżanowska K., Kunkel P., 2015. Testing monitoring methods of macrozoobenthos with particular reference to non-indigenous species – Port of Gdynia case study. IV Konferencja Młodych Naukowców z okazji Światowego Dnia Wody, 12–13 marca 2015, Poznań, str. 41.

Marszewska L., Normant M., Monitoring of benthic mobile epifauna in the port of Gdynia (Poland) – is the trap type important? Abstract Book 10th Baltic Sea Science Congress, 15–19 June, 2015 Riga, Latvia, str. 168.

Ojaveer H., Olenin S., Lehtiniemi M., Ezhova E., Jensen K.R., Narščius A., Normant M. Werner M., AQUANIS in action: comprehensive overview on the non-indigenous species invasions and the vectors responsible in the Baltic Sea, Abstract Book 10th Baltic Sea Science Congress, 15–19 June, 2015 Riga, Latvia, str. 14.

Puntila R., Ojaveer H., Granhag L., Normant M., Lehtiniemi M., Baseline surveys of non-indigenous species in the Baltic Sea ports - Testing and evaluating the HELCOM-OSPAR Port Survey Protocol, ICES Annual Science Conference (ASC) 2015, 21–25 September 2015, Copenhagen, Denmark.

Normant-Saremba M., Hidden passengers - the role of invasive crab *Eriocheir sinensis* in spreading of other taxa, AK Neozoen, Deutschen Gesellschaft für Limnologie e.V., 4 Dezember 2015, Universität Koblenz-Landau

Wiśniewska M., Szaniawska A., 2015. The influence of 17α-ethynyloestradiol (EE2) on the reproductive behavior of Gammarus tigrinus Sexton, 1939 – re-capture time experiments. 10th Baltic Sea Science Congress: "Science and innovation for future of the Baltic and the European regional seas", 15–19 June Riga, Latvia, 2015, 146

Wójcik D., Normant M., Jakubowska M., What tell us fifteen years studies about Chinese mitten crab *Paraeriocheir sinensis* from the Gulf of Gdańsk and Vistula Lagoon (southern Baltic Sea)? Abstract Book 10th Baltic Sea Science Congress, 15–19 June, 2015 Riga, Latvia, str. 141.

Wójcik D., Normant M., Living away from population: non-indigenous crab *Eriocheir sinensis* in the Vistula Lagoon (Poland). 50th European Marine Biology Symposium, 21–25 September 2015, Helgoland, Germany, Abstract Book str. 63.

6. References and bibliography

Andrulewicz, E., Witek, Z., 2002. Anthropogenic pressure and environmental effects on the Gulf of Gdańsk: recent management efforts. In; Schernewski G., Schiewer U., (eds.), Baltic Coastal Ecosystems: Structure, Function and Coastal Zone Management. Springer-Verlag, Berlin/Heidelberg/New York: 119–139.

Bącela, K., Grabowski, M., Konopacka, A., 2008. *Dikerogammarus villosus* (Sowinsky, 1894) (Crustacea, Amphipoda) enters Vistula – the biggest river in the Baltic basin. Aquatic Invasions vol.3, Issue 1: 95–98.

Bondar, C.A., Bottriell, K., Zeron, K., Richardson, J.S., 2005. Does trophic position of the omnivorous signal crayfish (*Pacifastacus leniusculus*) in a stream food web vary with life history stage or density? Canadian Journal of Fisheries and Aquatic Sciences, 62, 2632–2639. doi:10.1139/F05–167.

Brzeska, P., Woźniczka, A., Pełechaty, M., Blindow, I., 2015. New records of *Chara connivens* P. Salzmann ex A. Braun 1835 – an extremely rare and protected species in Polish brackish waters. Acta Societas Botanicorum Poloniae 84 (1): 143–146.

Cooper, R.B., 1981. Salinity tolerance of *Rangia cuneata* (Pelecypoda: Mactridae) in relation to its estuarine environment: a review. Walkerana 1: 19–31.

Dąbska, I., 1964. Charophyta – Ramienice. Warsaw: Polish Scientific Publishers PWN (Flora słodkowodna Polski vol.13).

Demel, K., 1953. Nowy gatunek w faunie Bałtyku. Kosmos 2: 105–106.

Dobrzycka-Krahel, A., Rzemykowska, H., 2010. First records of Ponto-Caspian gammarids in the Gulf of Gdansk (southern Baltic Sea). Oceanologia 52 (40): 727–735.

Dobrzycka-Krahel, A., Melzer, M., Majkowski, W., 2015. Range extension of *Dikerogammarus villosus* (Sowinsky, 1894) in Poland (the Baltic Sea basin) and its ability to osmoregulate in different environmental salinities. Oceanological and Hydrobiological Studies 44 (3): 294–304.

Dobrzycka-Krahel, A., Skóra, M.E., Raczyński, M., Szaniawska, A., 2015. Signal crayfish *Pacifastacus leniusculus* (Dana 1852) (Crustacea: Decapoda) – the highly invasive species enters the Polish coastal waters of the Baltic Sea. 10th Baltic Sea Science Congress "Science and innovation for future of the Baltic and the European regional seas" 15–19.06.2015, Riga (Latvia): 177.

Fowler, A.E., Forsström, T., von Numers, M., Vesakoski, O., 2013. The North American mud crab *Rhithropanopeus harrisii* (Gould, 1841) in newly colonized Northern Baltic Sea: distribution and ecology. Aquat. Inv. 8 (1): 89–96.

Guellard, T., Sokołowska, E., Arciszewski, B., 2015. First report on intersex in invasive round goby *Neogobius melanostomus* from the Baltic Sea (Gulf of Gdańsk, Poland). Oceanologia 57: 102–106.

Groves, J., Bullock-Webster, G.R., 1924. The British Charophyta. Volume II. Charae with plater, concluding artocles, geological sketch, bibliography and index. London: Ray Society.

Groves, R.E., 1985. The crayfish: its nature and nurture. Farnham: Fishing News Books, pp. 72.

Gruszka, P., Wawrzyniak –Wydrowska, B., Żurawska, J., 2003. Alien crustacean species in the River Odra estuary (Baltic Sea), In: Baltic Sea Science Congress 2003. Helsinki, Finland, August 24–28, 2003. Abstract Publication, p. 130 and poster.

Gruszka, P., Woźniczka, A., 2008. *Dikerogammarus villosus* (Sowinsky, 1894) in the River Odra estuary – another invader threating Baltic Sea coastal lagoons. Aquatic Invasions Vol. 3, Issue 4: 395–403.

HELCOM, 2010. Hazardous substances in the Baltic Sea – an integrated thematic assessment of hazardous substances in the Baltic Sea. Baltic environ. Proc. No. 1208.

Heese, T., 2013. Nowe stanowisko raka sygnałowego w wodach otwartych – dolna Wieprza. Przegląd Rybacki, 1: 3–5 (in Polish).

Hegele-Drywa, J., Normant, M., 2014. Non–native crab *Rhithropanopeus harrisii* (Gould, 1984) – a new component of the benthic communities in the Gulf of Gdańsk (southern Baltic Sea). Oceanologia. 56 (1): 125–139.

Hegele-Drywa, J., Thiercelin, N., Schubart, Ch. D., Normant-Saremba, M., 2015. Genetic diversity of the non-native crab *Rhithropanopeus harrisii* (Brachyura: Panopeidae) in the Polish coastal waters − an example of patchy genetic diversity at a small geographic scale. Oceanological and Hydrobiological Studies 44 (3): 305–315.

Heiler, K.C.M., Bij de Vaate, A., Ekschmitt, K., von Oheimb, P.V., Albrecht, C., Wilke, T., 2013. Reconstruction of the early invasion history of the quagga mussel *(Dreissena rostriformis bugensis)* in Western Europe. Aquat. Invasions 8(1): 53–57.

Holdich, D.M., 1988. The dangers of introducing alien animals with particular reference to crayfish. Freshwater Crayfish, 7: 15–30.

Holdich, D.M., Harlioglu, M.M., Firkins, I., 1997. Salinity adaptations of crayfish in British waters with particular references to *Austropotamobius pallipes, Astacus leptodactylus* and *Pacifastacus leniusculus*. Estuarine, Coastal and Shelf Science, 44: 147–154.

Janta, A., 1996. Recovery of the crab *Rhithropanopeus harrisii* (Gould) *tridentatus* (Maitland) population in the Dead Vistula Estuary (Baltic Sea, Poland). In: Crangon, Iss. Mar. Biol. Centre, Gdynia, Proc. 2nd Estuary Symp., Gdańsk, October 1993: 37–41.

Jensen, K.R., Knudsen, J., 2005. A summary of alien marine benthic invertebrates in Danish waters. Oceanol. Hydrobiol. Stud. 34 (1): 137–162.

Karatayev, A.Y., Burlakova, L.E., Padilla, D.K., 2015. Zebra versus quagga mussels: a review of their spread, population dynamics, and ecosystem impacts. Hydrobiologia 746 (1): 97–112.

Konopacka, A., 2004. Inwazyjne skorupiaki obunogie (Crustacea, Amphipoda) w wodach Polski. Przegląd Zoologiczny 48: 141–162.

Kouba, A., Petrusek, A., Kozák, P., 2014. Continental-wide distribution of crayfish species in Europe: update and maps. Knowledge and Management of Aquatic Ecosystems 413: 05.

Kossakowski, J., Mnich, M., Kossakowski, G., 1978. The first introduction of the crayfish *Pacifastacus leniusculus* Dana into Polish waters. Freshwater Crayfish, 4: 195.

Kotta, J., Ojaveer, H., 2012. Rapid establishment of the alien crab *Rhithropanopeus harrisii* (Gould) in the Gulf of Riga. Estonian J. Ecol. 61 (4): 293–298.

Krause, W., 1997. Charales (Charophycae). Süsswasserflora von Mitteleuropa. Jena: Gustav Fischer Verlag.

Kujawa, S., 1957. Biology and culture of the crab *Rhithropanopeus harrisii* (Gould) subsp. tridentatus (Maitland) from Vistula Lagoon. Wszechświat 2: 57–59 (in Polish).

Luther, H., 1979. *Chara connivens* in the Baltic Sea area. Ann Bot Fennici 16: 141–150.

Maitland, R.T 1874. Naamlijst van Nederlandsche Schaaldieren. Tijdsch Nederl Deirk Ver 1: 228–269.

Mason, J.C., 1975. Crayfish production in a small woodland stream. Freshwater Crayfish, 2: 449–479.

Matthews, J., Van der Velde, B., Bij de Vaate, A., Collas, F.P.L., Koopman, K.R., Leuven, R.S.E.W., 2014. Rapid expansion of the invasive quagga mussel in relation to zebra mussel presence in the Netherlands and Western Europe. Biol. Invasions 16 (10): 23–42.

Müller, O., Zettler, M.L., Gruszka, P., 2001. Verbreitung and Status von *Dikerogammarus villosus* (Sowinsky 1894) (Crustacea: Amphipoda) in der mittleren und unteren Strom-Oder und den angrenzenden Wasserstraßen. Lauterbornia 41: 105–112.

Michalski, K., 1957. *Rhithropanopeus harrisii subsp. tridentate* (Mtl.) in the Rivers Vistula and Motława. Przegląd Zoologiczny 1: 68–69 (in Polish).

Momot, W.T., Growing, H., Jones, P.D., 1978. The dynamics of crayfish and their role in ecosystems. The American Midland Naturalist, 99 (1): 277–283.

Nehring, S., Leuchs, H., 1999. *Rhithropanopeus harrisii* (Gould, 1841) (Crustacea: Decapoda) – ein amerikanisches Neozoon im Elbeästuar. Lauterbornia 35: 49–51.

Normant, M., Miernik, J., Szaniawska, A., 2004. Remarks on the morphology and the life cycle of *Rhithropanopeus harrisii tridentatus* (Maitland) from the Dead Vistula River. Oceanol. Hydrobiol. Stud. 33 (4): 93–102.

Pfitzenmeyer, H.T., Drobeck, K.G., 1964. The occurrence of brackish water clam *Rangia cuneata*, in the Potomac River, Maryland. Chesapeake Sci. 5 (4): 209–215.

Pliński, M., Kreńska, B., Wnorowski, T., 1978. Stosunki florystyczne i biomasa roślinności naczyniowej Zalewu Wiślanego. Studia i Materiały Oceanologiczne 21: 161–196.

Projecto-Garcia, J., Cabral, H., Schubart, C.D., 2010. High regional differentiation in a North American crab species throughout its native range and invaded European waters: a phylogeographic analysis. Biol. Inv. 12: 253–263.

Rodriguez, G., Suarez, H., 2001. Anthropogenic dispersal of decapod crustaceans in aquatic environments. Interciencia 26 (7): 282–288.

Rutledge, P.S., Pritchard, A.W., 1981. Scope of activity in the crayfish *Pacifastacus leniusculus*. American Journal of Physiology, 240: 87–92.

Rychter, A., 1997. Effect of anoxia on the behaviour, haemolymph lactate and glycogen concentrations in the mud crab *Rhithropanopeus harrisii ssp. tridentatus* (Maitland) (Crustacea: Decapoda). Oceanologia 39 (3): 325–335.

Rychter, A., 1999. Energy value and metabolism of the mud crab *Rhithropanopeus harrisii tridentatus* (Crustacea, Decapoda) in relation to ecological conditions. Ph.D. thesis. University of Gdańsk, Gdynia (in Polish).

Skóra, K.E., Stolarski, J., 1993. New fish species in the Gulf of Gdańsk, *Neogobius sp.* [cf. *Neogobius melanostomus* (Pallas 1811)]. Bull. Sea Fish Inst. 1 (128): 83–84.

Śmietana, P., Krzywosz, T., 2006. Determination of the rate of growth of *Pacifastacus leniusculus*, in Lake Pobłędzie using polymodal length frequency distribution analysis. Bulletin Français de la Peche et de la Pisciculture, 380–381: 1229–1244.

Śmietana, P., 2011. *Pacifastacus leniusculus* (Dana, 1852) in: Alien species in the fauna of Poland. Institute of Nature Conservation - Polish Academy of Sciences in Cracow, ed: Głowaciński, Z., Okarma, H., Pawłowski, J., Solarz, W.: 201–205.

Torn, K., Martin, G., 2003. *Chara connivens* Salzm. ex A. Braun 1835. In: Schubert H, Blindow I editors. Charophytes of the Baltic Sea. Ruggell: Baltic Marine Biologists. Vo.19. Gantner Verlag: 82–88.

Turoboyski, K., 1973. Biology and ecology of the crab *Rhithropanopeus harrisii ssp. tridentatus*. Mar. Biol. 23 (4): 303–313.

Warzocha, J., Szymanek, L., Wodzinowski, T., 2015. The first report on the establishment and spread of the alien clam *Rangia cuneata* (Mactridae) in the Polish part of the Vistula Lagoon (southern Baltic). Oceanologia 58: 54–58.

Whitledge, G.W., Rabeni, C.F., 1997. Energy sources and ecological role of crayfish in an Ozark stream: insights from stable isotopes and gut analysis. Can. J. Fish. Aquat. Sci., 54, 2555–2563.

Wood, R. D., Imahori, K.A., 1965. Revision of the Characeae. First part: monograph of the Characeae. Weinheim: J. Cramer Verlag.

Woźniczka A., Wawrzyniak-Wydrowska B., Radziejewska T., Skrzypacz A., 2016. The quagga mussel (*Dreissena rostriformis bugensis* Andrusov, 1897) – another Ponto-Caspian dreissenid bivalve in the southern Baltic catchment: the first record from the Szczecin Lagoon. Oceanologia. In press.

Portugal

Compiled by Paula Chainho, with contributions from Ana Cristina Costa (CIBIO, University of Azores), Bernardo Duarte (MARE, University of Lisbon), Estibaliz Berecibar (EMEPC), Filipe Ribeiro (MARE, University of Lisbon), Francisco Arenas (CIIMAR, University of Porto), Joana Micael (CIBIO, University of Azores), João Canning-Clode (MARE, Madeira), Miriam Guerra (IPMA), Rosa Freitas (CESAM, University of Aveiro) and Stefania Chiesa (CESAM, University of Aveiro)

CIBIO - Research Centre in Biodiversity and Genetic Resources

EMEPC - Task Group for the Extension of the Continental Shelf

CIIMAR - Interdisciplinary Centre of Marine and Environmental Research

IPMA - Portuguese Sea and Atmosphere Institute

CESAM - Centre for Environmental and Marine Studies

Overview

A list of 143 aquatic non-indigenous species (NIS) is registered for the Portuguese estuarine and coastal aquatic systems and there were four new additions to the 2015 report. The inventory of NIS was restructured to include salt marsh species and cryptogenic species are not included. Portugal has a law on introduction of non-indigenous species, published in 1999, which is currently under revision and a list of invasive marine species is included in the submitted document. Surveys conducted recently in the aim of ongoing projects that address NIS confirmed the occurrence of several species previously recorded, including the Manila clam (*Ruditapes philippinarum*) and the soft-shell clam (*Mya arenaria*), different bryozoans (*Watersipora subtorquata*, *Ticellaria inopinata* and *Bugula neritina*) and tunicates (*Styela plicata*, *Styela clava*, *Microcosmus squamiger* and *Botrylloides violaceus*), the blue crab (*Callinectes sapidus*), the estuarine mud crab (*Rhithropanopeus harrisii*) and the mummichog (*Fundulus heteroclitus*). *Spartina patens* has been identified in several different estuarine systems as an abundant species in salt marsh areas.

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

There are no new regulations.

Decree-law 565/99, 21th December 1999, defines the legal restrictions to the introduction of exotic species (marine species are not listed). Although this decree has been under revision since 2009, in 2016 the lists of non-indigenous species were revised again and included invasive marine species. Public consultation did not start yet.

2. Intentional introductions

Information available for introductions in Portuguese estuarine and coastal waters is insufficient to separate between intentional and unintentional introductions.

3. Unintentional introductions

A list of 143 aquatic non-indigenous species (NIS) is registered for the Portuguese estuarine and coastal aquatic systems. New additions to the 2015 report are listed in Table 1. New additions for Portuguese mainland and Azores and Madeira islands were considered separately. Possible introduction vectors were indicated based on the life cycle of the introduced species and the presence of known introduction vectors at locations where it was registered. The inventory of NIS was reformulated to include saltmarsh macrophyte species but freshwater species and cryptogenic species are not included. A first national comprehensive list of NIS for Portuguese coastal areas, including the Iberian coast and Macaronesia islands was published (Chainho *et al.*, 2015). New records were registered mainly for the Madeira and Azores islands as a result of comprehensive literature reviews and recent surveys carried out in the islands.

Macrophytes

Spartina patens (Gramineae) is an American coastal grass which grows in a wide range of coastal habitats in its native area. It was recorded for the Iberian Peninsula in 1999 (SanLéon *et al.*, 1999) although it was probably introduced a long time ago. Those authors indicated its occurrence at Ria de Aveiro, Tagus estuary, Sado estuary, Ria Formosa. Duarte *et al.* (2015) confirmed its high abundance at the Tagus estuary and a recent study indicates that the introduction occurred in the end of the 19th and at the beginning of the 20th centuries, but it has been identified as *Spartina versicolor* Fabre (Baumel *et al.*, *accepted*).

Polychaetes

Live bait trade

The live bait import was investigated to understand its role as NIS introduction vector in Portugal. Three different polychaete species (*Glycera dibranquiata, Perinereis linea, Perinereis cultrifera*) and a sipunculida species (*Sipunculus nudus*) were identified in the live bait boxes imported to mainland Portugal (unpublished data), while only *P. linea* was identified as an imported species in the Azores islands (Micael *et al.*, 2016). Of these, only *G. dibranchiata*, *P. linea* are considered as NIS, the first imported from the USA and the second from China. Bait boxes bought from retailers in different locations at mainland Portugal were examined to look for the presence of hitchhiker species but only 3 nematodes were found in all boxes examined, unlike what was found in similar studies conducted in the USA (Fowler *et al.*, 2015). None of these non-indigenous species has been recorded in the natural environment up to now (Chainho *et al.*, 2015; Micael *et al.*, 2016).

Bryozoans and Tunicates

Surveys conducted by the Marine and Environmental Sciences Centre (MARE) and the Task Group for the Extension of the Continental Shelf (EMEPC), in the aim of ongoing projects, confirmed the dominance of a several species of bryozoans and tunicates in recreational marinas and harbor areas. The bryozoans *Watersipora subtorquata*, *Ticellaria inopinata* and *Bugula neritina* and the tunicates *Styela plicata*, *Styela clava*, *Microcosmus squamiger* and *Botrylloides violaceus* were the most abundant.

Molluscs

Ruditapes philippinarum

The Manila clam was introduced in Portugal in 1984 and currently has established populations in three estuarine systems (Ria de Aveiro, Tagus estuary and Sado estuary), two coastal lagoons (Óbidos and Albufeira lagoons) and the Ria Formosa coastal area. It has highly abundant populations in the estuarine systems, in particular in the Tagus estuary.

Sampling surveys carried out during 2015 confirmed that the Manila clam population continues to occur with high densities in the Tagus estuary in spite of the massive harvesting of that species along the last 6 years. *Ruditapes philippinarum* and *Scrobicularia plana* are the dominant bivalve species in the Tagus estuary, where nearly 1700 harvesters have been estimated, most of which are illegal (Ramajal *et al.*, *subm*). In 2014 there was an estimated crop ranging between 3.300 ton and 17.000 ton/year. The estimated economic revenue for the harvesters value chain level oscillated between 10.000.000 and 23.500.000 €/year (Ramajal *et al.*, *subm*).

A recent study using biogeographic and phylogenetic analyses based on 16S rDNA of introduced Manila clam populations in Italy, Spain, and Portugal from both Mediterranean (Adriatic) and Atlantic sampling sites, showed a complex scenario, dominated by multiple introductions of individuals coming from different sources (Chiesa *et al.*, 2014). This scenario was confirmed by additional data based on *COI gene* fragment sequencing including also French and British populations (Chiesa *et al.*, subm). Moreover, a lack of geographic structuring was observed among European populations by microsatellites genotyping (Chiesa *et al.*, 2016).

Mya arenaria

This species was firstly recorded in the Tagus estuary in 2007, with an established population (Conde *et al.*, 2009). In 2015 it was recorded again, in a location upstream to the first record.

Crustaceans

The blue crab (*Callinectes sapidus*) was firstly recorded at the in the Tagus estuary in 1978 (Gaudêncio & Guerra, 1979) and after that Sado estuary in 1993 (D. Sobral, *com. pess*). There are frequent registers of its occurrence in that estuary since 2009 (Ribeiro & Verissimo, 2014) and fisherman report accidental captures of 4–5 specimens every year, indicating the most likely occurrence of an established population, but with no apparent expansion. Surveys conducted in 2015 in the aim of the project Promar- Manila clam also confirmed the occurrence of *Rhithropanopeus harrisii* in the Tagus estuary.

Fishes

Fundulus heteroclitus

The Mummichog was restricted to the Guadiana estuary since 1975 and is associated to the mudflat channels in this estuary. However, in the recent years there are occasional records of this species in the Ria Formosa (Guerreiro, P. pers. comm.) which depict a westward expansion of this species in Portugal.

Table 1. List of new NIS registered in Portuguese waters in 2015/2016.

Taxa	Year of first record	Location of first record	Possible introduction vector	Invasion Status	References
Amathia verticillata Della Chiaje, 1828	1937	Ria Formosa, Berlengas	Fouling	Established	Nobre, 1937
Bugula stolonifera Ryland, 1960	2004	Ria de Aveiro	Fouling	Established	Marchini *et al.*, 2007
Caprella scaura Templeton, 1836	2013	Azores	Fouling	Unknown	Gillon *et al.*, 2015
Caulerpa webbiana Montagne	1974	Madeira	Fouling	Established	Levring, 1974

Chaetopleura angulata (Spengler, 1797)	1916	Portuguese coast	Unknown	Established	Hidalgo, 1916
Ciona intestinalis (Linnaeus, 1767)	2015	Azores (São Miguel)	Fouling	Unknown	Marina *et al.*, 2015
Laurencia dendroidea J. Agardh, 1852	2001	Madeira	Unknown	Unknown	Prud'homme van Reine *et al.*, 1994
Microcosmus squamiger Michaelsen, 1927	2015	Azores (São Miguel, Santa Maria, Flores)	Fouling	Unknown	A.C. Costa, J. Micael, *com. pess.*
Neosiphonia sphaerocarpa (Børgesen) M.-S. Kim & I.K. Lee	2001	Madeira	Fouling	Unknown	Haroun *et al.*, 2002
Pisa carinimana Miers (1879)	2013	Madeira	Fouling	Unknown	Ramalhosa *et al.*, 2014
Saccostrea cucullata (Born, 1778)	2007	Sagres	Fouling	Established	Trigo e Rolán, 2010
Spartina patens (Aiton) Muhl.	1999	Ria de Aveiro, Tagus estuary, Sado estuary, Ria Formosa	Unknown	Established	SanLéon *et al.*, 1999
Tonicia atrata (Sowerby, 1840)	1985	Sado estuary	Fouling; Ballast water; Aquaculture	Unknown	Arias & Anadón, 2013
Tricellaria inopinata Ambrogi, 1985	2015	Azores (São Miguel, Santa Maria)	Fouling	Unknown	A.C. Costa, J. Micael, *com. pess.*

5. Meetings and projects

Meetings

2016. Canning-Clode J & Jamtes T. Carlton. Poleward Creep Punctuated by Set Backs & Surges: Refining Climate Change Scenarios for Marine Non-Indigenous Species. 9th International Conference on Marine Bioinvasions, Sydney, Australia. Abstract book, page 14.

2015. Chiesa, S., P. Chainho, F. Ruano. Country report: Portugal. Keynote invited speaker at "Third International Symposium on Manila (Asari) clam", organized by Fisheries Research Agency of Japan. June 1–3, 2015. Tsu city, Mie Prefecture, Japan.

2015. Chiesa S., L. Lucentini, R. Freitas, F. Nonnis Marzano, S. Breda, E. Figueira, N. Caill-Milly, R. Herbert, A.M.V.M. Soares, E. Argese. Mapping the stranger: genetic diversity of Manila clam in European coastal lagoons. Keynote invited speaker at "Third International Symposium on Manila (Asari) clam", organized by Fisheries Research Agency of Japan. June 1–3, 2015. Tsu city, Mie Prefecture, Japan.

2016. Gestoso I., Ramalhosa P., Oliveira P. & Canning-Clode J. Impact of rafting marine debris and non-indigenous species in the marine protected areas of the Madeira archipelago (NE Atlantic). 9th International Conference on Marine Bioinvasions, Sydney, Australia. Abstract book, page 37.

2016. Micael J., Jardim N., Núñez C., Costa, A.C. Management actions for non-indigenous Bryozoa. 9th International Conference on Marine Bioinvasions - ICMB, 19–21 January 2016, Sydney, Australia.

2015. Bettencourt A, Micael J, Costa AC, Seca AML, Barreto MC 2015. Antitumor Activities of Invasive Alien Species from the Azores. Congresso de Química Orgânica e Química Terapêutica, 1–3 December, Sociedade Portuguesa de Quimica, Porto, Portugal.

2015. Bettencourt A., Micael J., Seca A.M.L., Barreto M.C., Costa A.C. Biological activities and secondary metabolites from marine alien species from the Azores. Seminar Marine Non-Indigenous Species – 18th February, University of the Azores, Ponta Delgada, Portugal.

2015. Canning-Clode J. Impacts of invasive species in marine ecosystems. IX Encontro Regional Eco-Escolas da Região Autónoma da Madeira 2015.

2015. Canning-Clode J. Climate Change Impacts on the Establishment and Spread of Non-Indigenous Species: Salinity Change effects on NIS. ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO), Bergen, Norway.

2015. Canning-Clode J, Marques T, Chainho P, Fofonoff P, McCann L, Carlton JT, Ruiz GM, Santos RS. Spatial and Temporal Patterns in Marine Invasions in the Offshore Islands of Macaronesia. International Workshop on Marine Bioinvasions of Tropical Island Ecosystems. Puerto Ayora, Galápagos, Ecuador, February 24–27, 2015.

2015. Carvalho, F.B., L. Garaulet, M. Gaspar, J. Ramajal, J.L. Costa & P. Chainho. Current status of the Manila clam population, na introduced and intensively explored species in the Tagus estuary. 5º BRASPOR network meeting, 5–8 October, Mértola, Portugal.

2015. Chainho, P., E.J. Cook, B. Galil, S. Gollasch, P. Goulletquer, F. Kerckhof, M. Lehtiniemi, C. McKenzie, D. Minchin, A. Occhipinti-Ambrogi, S. Olenin, H. Ojaveer. A cross-regional comparison of non-indigenous species indicators: problems and opportunities for a common assessment. ICES Annual Science Conference, 21 – 25th September, Copenhagen, Denmark.

2015. Marina J.G., Micael J., Costa A.C. A new non-indigenous species report: *Ciona intestinalis* (Linnaeus, 1767) in Vila Franca do Campo marina. Seminar Marine Non-Indigenous Species – 18th February, University of the Azores, Ponta Delgada, Portugal.

2015. Ramajal, J., D. Piccard, J.L. Costa, F. Carvalho, M.B. Gaspar & P. Chainho. Is the Manila clam an ecological threat or highly valuable resource? Portuguese Malacology Congress. Lisbon, Portugal, May 1–2.

2015. Ramajal, J., D. Piccard, J.L. Costa, F. Carvalho, M.B. Gaspar & P. Chainho. Manila clam, a new reality in the Tagus estuary. Fishery reorganization and economic pressure versus environmental impacts. 5º BRASPOR network meeting, 5–8 October, Mértola, Portugal.

2015. Santos R., Ferreira A., Micael J., Gil-Rodríguez M.C., Machín M., Costa A.C., Gabriel D., Costa F.O., Saunders G.W., Parente M.I. 2015. Genetic characterization of the red algae *Asparagopsis armata* and *Asparagopsis taxiformis* (Bonnemaisoniaceae) from the Azores. 6th International Barcode of Life Conference – 18th-21th August, Guelph, Canada.

Projects:

- 2014–2016. Manila clam – Current state of the Tagus estuary population, impacts and fishing management. Developed by the Marine and Environmental Sciences Centre (MARE), DGRM - Direção Geral de Recursos Naturais, Segurança e Serviços Marítimos, IPMA, University of Évora and CRIA. Funded by the Fisheries Program PROMAR.
- 2015–2016. Current status of the Portuguese oyster (*Crassostrea angulata*) in the Sado estuary, threats and opportunities for its commercial exploitation – CRASSOSADO. Developed by the Marine and Environmental Sciences Centre (MARE), IPMA, ICNF and University of Aveiro. Funded by PORTUCEL, S.A.

- 2014–2016. Alive bait – Polychaetes used as alive bait in Portugal: harvesting management, importation and culture. Developed by the Marine and Environmental Sciences Centre (MARE), University of Évora, CRIA and IPL. Funded by the Fisheries Program PROMAR.
- 2013–2015. The Madeira Monitoring Marine Invasive Species Program (Mad_MOMIS)

Developed by João Canning-Clode's working grup at the Madeira unit of MARE – Marine and Environmental Sciences Centre, is still in place with periodic surveys in marinas, harbors, dry dock inspections and marine debris inspections (More info at www.canning-clode.com). As a result, new records of invasive species have been detected, particularly bryozoans and ascidians. Several manuscripts are currently in review and in preparation highlighting these findings.

- 2015-. Anthropogenic pressures in the Marine Protected Areas (MPA) of Madeira.

This project was launched in 2015 in Madeira to investigate anthropogenic pressures in the Marine Protected Areas (MPA) of Madeira, including non-indigenous species, marine litter and pollution. This project is being developed by Dr. Ignacio Gestoso and was recently presented at the Internacional Conference of Marine Bioinvasions, held in Sydney, Australia. Results from a pilot study conducted in Madeira suggest MPA could act as a biological barrier (biotic resistance) for NIS introductions (Gestoso *et al.* 2016). A Manuscript highlighting these novel findings is currently in preparation and should be submitted this spring.

- 2015 – 2017 Programa Invasoras Marinhas nos Açores (PIMA)

A regional monitoring program has been launched in December 2015 by Regional Government of the Azores (Concurso Público nº 3/2015/DRAM) and will be carried out for 20 months. The objective is to update the state of the art regarding the marine NIS in the archipelago, including the main introduction vectors and environment conditions that facilitate their spread within the archipelago and to develop a plan of action, including a monitoring plan targeting the marine NIS in the region.

- 2015–2016. SOPHIA – Marine Environment literacy platform.

  Program PT02 – Integrated management for marine and coastal waters. Developed by the Marine and Environmental Sciences Centre (MARE), DGRM - Direção Geral de Recursos Naturais, Segurança e Serviços Marítimos, IDL and Higher School of Communication and Media Studies. Funded by EEA Grants.

  The primary objective of the SOPHIA project is the training of human resources through scientific and technological actions to ensure skills for the implementation of the monitoring program and the program of measures of the MSFD (Marine Strategy Framework Directive). The training aims to provide knowledge about ecology, law of the sea and monitoring tools to senior technicians of the Central and Regional Administration, graduates and post graduates of research centers, technical NGOs and technical companies and agencies that will be involved in implementing the MSFD in the following areas: ecology of the deep sea; Dynamics of the food webs; satellite image interpretation for the sea; Geographic Information Systems to the sea; international law of the sea and implementation of EU policies.

- 2015–2016 - BioMar PT - Get to know the marine environment of Portugal

The EEA financed literacy project "BioMar PT - Get to know the marine environment of Portugal", developed by the Portuguese Sea and Atmosphere Institute (promoter), the CIIMAR-Interdisciplinary Centre for Marine and Environmental Research and The Task Group for the Extension of the Continental Shelf (EMEPC), is providing free training courses on the identification and monitoring of NIS and related human activities, either those responsible for NIS introduction, or the ones that are negatively affected by the introduction and spread of NIS in the Portuguese marine environment. The focus is on molluscs, crustaceans, bryozoans and macroalgae. Technical guides are provided in each course, which are available on line (http://biomarpt.ipma.pt/). The target trainees are senior technicians, graduates and alumni working in public and private sectors in priority areas for the MSFD implementation. The objective is to contribute to qualify human resources in planning and conducting NIS monitoring (including surveillance, early detection, pathways and vectors of introduction, sampling and identification), thus contributing to improve the assessment of GES, at national and regional levels, under the MSFD implementation activities.

Future Projects:

- National Monitoring Program – A national monitoring program on non-indigenous species is currently under preparation, aiming at contributing to implementation of the Marine Strategy Framework Directive in mainland Portugal. The program was submitted to the national authority coordinating the MSFD implementation and awaits funding.

6. Publications

Ávila, S., P. Madeira, A. Rebelo, C. Melo, A. Hipólito, J. Pombo, A. Botelho, R. Cordeiro 2015 *Phorcus sauciatus* (Koch, 1845) (Gastropoda: Trochidae) in Santa Maria, Azores archipelago: the onset of a biological invasion. Journal of Molluscan Studies 81 (4): 516–521.

Chainho, P., A. Fernandes, A. Amorim, S. Ávila, J. Canning-Clode, J. Castro, A. Costa, J.L. Costa, T. Cruz, S. Gollasch,C. Grazziotin-Soares, R. Melo, J. Micael, M. Parente, J. Semedo, T. Silva, D. Sobral, M. Sousa, P. Torres, V. Veloso & M.J. Costa. 2015. Non-indigenous species in Portuguese coastal areas, coastal lagoons, estuaries, and islands. Estuarine, Coastal & Shelf Science 167: 199–211.

Chiesa S., L. Lucentini, R. Freitas, F. Nonnis Marzano, C. Ferrari, L. Filonzi, S. Breda, F. Minello, E. Figueira & E. Argese. 2016. Null alleles of microsatellites for Manila clam *Ruditapes philippinarum*. Animal Genetics 47: 135–136.

Chiesa S., L. Lucentini, R. Freitas, F. Nonnis Marzano, S. Breda, E. Figueira, N. Caill-Milly, R.J.H. Herbert, A.M.V.M. Soares & E. Argese. (*subm.*). A history of invasion: COI phylogeny of Manila clam *Ruditapes philippinarum* in Europe. Fisheries Research.

Duarte, B., Santos, D., Marques, J.C. and Caçador, I., 2015. Ecophysiological constraints of two invasive plant species under a saline gradient: halophytes versus glycophytes. Estuarine Coastal and Shelf Science 167, 154–165 (10.1016/j.ecss.2015.04.007).

Duarte, B., Baeta, A., Rousseau-Gueutin, M., Ainouche, M., Marques, J.C. & Caçador, I., 2015. A tale of two Spartinas: Climatic, photobiological and isotopic insights on the fitness of non-indigenous versus native species. Estuarine, Coastal and Shelf Science 167, 178–190 (10.1016/j.ecss.2015.06.015).

Duarte, B., Marques, J.C. & Caçador, I., (*in press*). Ecophysiological responses of native and invasive Spartina species to extreme temperature events in Mediterranean marshes. Biological Invasions (10.1007/s10530–015–0958–4).

Engelen, A.H., A. Serebryakova, P. Ang, K. Britton-Simmons, F. Mineur, M.F. Pedersen, F. Arenas, C. Fernandez, H. Steen, R. Svenson, H. Pavia, G. Toth, F. Viard & R. Santos. 2015. Circumglobal invasion by the brown seaweed *Sargassum muticum*. Oceanography and Marine Biology 53:81–126.

Marques, F., P. Chainho, J.L. Costa, I. Domingos, & M.M. Angélico. 2015. Abundance, seasonal patterns and diet of the non-native jellyfish *Blackfordia virginica* in a portuguese estuary. Estuarine, Coastal & Shelf Science 167: 212–219.

Micael J., Jardim N., Núñez C., Occhipinti-Ambrogi A., Costa A.C. (*in press*). Some Bryozoa species recently introduced into the Azores: reproductive strategies as a proxi for further spread. Helgoland Marine Research.

Micael J., Sonsona R., Costa A.C. 2016. The potential of marine live-bait introductions into oceanic islands. Journal of Coastal Conservation: Planning and Management. DOI: 10.1007/s11852–016–0426-z

Ramajal, J., D. Piccard, J.L. Costa, F. Carvalho, M.B. Gaspar & P. Chainho. Manila clam, a new reality in the Tagus estuary. Fishery reorganization and economic pressure versus environmental impacts. 5º Encontro da Rede BRASPOR, 5–8 October, Mértola, Portugal.

Velez C., Figueira E., Soares A., Freitas R. (2015) Spatial distribution and bioaccumulation patterns in three clam populations from a low contaminated ecosystem. Estuarine Coastal And Shelf Science. 155, 114–125.

Velez C., Galvão P., Longo R., Malm O., Soares A.M.V.M., Figueira E., Freitas R. (2015) *Ruditapes philippinarum* and *Ruditapes decussatus* under Hg environmental contamination. Environmental Science and Pollution Research. 22, 15, 11890–11904.

7. References and bibliography

Arias, A. & N. Anadon. 2013. *Tonicia atrata* and *Chiton cumingsii* (Polyplacophora: Chitonidae): First records in European waters. Zootaxa 3626: 593–596.

Chiesa, S., L. Lucentini, R. Freitas, F. Nonnis Marzano, F. Minello, C. Ferrari, L. Filonzi, E. Figueira, S. Breda, G. Baccarani & E. Argese. 2014. Genetic diversity of introduced Manila clam *Ruditapes philippinarum* populations inferred by 16S rDNA. Biochemical Systematics and Ecology 57: 52–59.

Baumel, A., Rousseau-Gueutin, M., Sapienza-Bianchi, C., Gareil, A., Duong, N., Rousseau, H., Coriton, O., Amirouche, R., Sciandrello, S., Duarte, B., Caçador, I., Castillo, J.M. and Ainouche M. (*accepted*) *Spartina versicolor* Fabre: Another case of *Spartina* trans-Atlantic introduction? Biological Invasions.

Duarte, B., Santos, D., Marques, J.C. and Caçador, I., 2015. Ecophysiological constraints of two invasive plant species under a saline gradient: halophytes versus glycophytes. Estuarine Coastal and Shelf Science 167, 154–165 (10.1016/j.ecss.2015.04.007).

Fowler, A. E., Blakeslee, A. M. H., Canning-Clode, J., Repetto, M. F., Phillip, A. M., Carlton, J. T., Moser, F. C., Ruiz, G. M., Miller, A. W. (2015), Opening Pandora's bait box: a potent vector for biological invasions of live marine species. Diversity and Distributions. doi: 10.1111/ddi.12376

Gaudêncio, M.J., Guerra, M.T., 1979. Note sur lá préesence de *Callinectes sapidus* Rathbun 1896 (Crustacea Decapoda Brachyura) dans l'estuaire du Taje. Bol. Do Inst. Nac. Investig. das Pescas 2, 67e73.

Gillon A., Micael J., Costa A.C. 2015. First record of the non-indigenous caprellid *Caprella scaura* Templeton, 1836 (Crustacea: Amphipoda) in the Azores. Seminar Marine Non-Indigenous Species – 18th February, University of the Azores, Ponta Delgada, Portugal.

Haroun, R., M.C. Gil-Rodríguez & J. Díaz de Castro 2002. A Checklist of the marine plants from the Canary Islands (Central Eastern Atlantic Ocean). Botanica Marina 45: 139–169.

Hidalgo, J.C. 1916. Fauna malacológica de España, Portugal y las Baleares. Moluscos Testáceos marinos. Trabajos del Museo Nacional de Ciencias Naturales (Serie Zoología) 30: 1–752.

Levring, T. 1974. The marine algae of the Archipelago of Madeira Islands. Boletim do Museu Municipal de Funchal 28: 5–111.

Marchini, A., M.R. Cunha & A. Occhipinti-Ambrogi. 2007. First observations on bryozoans and entoprocts in the Ria de Aveiro (NW Portugal) including the first record of the Pacific invasive cheilostome Tricellaria inopinata. Marine Ecology 28: 154–160.

Marina, J.G., Micael J., Costa A.C. 2015. A new non-indigenous species report: *Ciona intestinalis* (Linnaeus, 1767) in Vila Franca do Campo marina. Seminar Marine Non-Indigenous Species – 18th February, University of the Azores, Ponta Delgada, Portugal.

Micael, J., R. Sonsona & A.C. Costa. 2016. The potential of marine live-bait introductions into oceanic islands. J Coast Conserv. DOI 10.1007/s11852–016–0426-z

Nobre A. 1937. Mem. e Est. do Museu Zoológico da Universidade de Coimbr, 93: 1–30.

Prud'homme van Reine, W.F., R.J. Haroun & P.A.J. Audiffred. 1994. A reinvestigation of macaronesian seaweeds as studied by A. Piccone. With remarks on those by A. Grunow. Nova Hedwigia 58: 67–121.

Ramajal, J., D. Piccard, J.L. Costa, F. Carvalho, M.B. Gaspar & P. Chainho (subm.). Amêijoa-japonesa, uma nova realidade no rio Tejo. Manila clam, a new reality in the Tagus estuary. Proceedings of the IV Encontro da Rede BRASPOR.

Ramalhosa P, Canning-Clode J, Biscoito M, (2014) First record of *Pisa carinimana* (Decapoda: Epialtidae) from Madeira Island (Northeastern Atlantic Ocean) Bocagiana. Museu de História Nacional do Funchal 239: 1–7 ISSN 2183–3141

Ribeiro, F., Veríssimo, A., 2014. A new record of *Callinectes sapidus* in a western European estuary (Portuguese coast). Mar. Biodivers. Rec. 7, e36.

SanLéon, D.G., J. Izco & J.M. Sánchez. 1999. *Spartina patens* as a weed in Galician saltmarshes (NW Iberian Peninsula). Hydrobiologia 415: 213–222.

Trigo, J. & Rolán, E. (2010. *Saccostrea cucullata* (Born, 1778) en la Península Ibérica. Noticiario SEM, 53.

Russia

Prepared by Elena Ezhova, with contribution of Natalia Molchanova, Olga Kocheshkova (AB IORAS) and Andrey Gusev (AnlantNIRO)

Overview

Like in a previous years, the special kind of national NIS monitoring program is not established for Russian marine area. Information on appearance and distribution of aliens is collecting as a part of diverse national and regional monitoring surveys. Several species, new for national areas of Baltic Sea and Sea of Azov, were recorded during 2014–2015. Four new polychaete species could be regarded as NIS: Sabellid polychaetes *Laonoma calida* (?) was recorded first time in the Vistula Lagoon (Baltic Sea) in 2015. Later, the analysis of samples of 2013–2014 proved its presence in the area since June 2014. Other sabellid *Aracia heterobranchiata* (?) was recorded in the deltaic region of the Don River (Sea of Azov), also in 2014. Two more alien polychaete species of the genus *Marenzelleria* were collected in the Don River estuary and the Taganrog bay (Sea of Azov) in 2014. Most probable vector for all these introductions – ballast water; all mentioned species have demonstrated the signs of reproduction in the new areas. Taxonomic position of all 4 species is under consideration now.

Gammarids *Dikerogammarus vilosus* and *Dikerogammarus haemobaphe*, - other species, recorded firstly for the marine coastal zone of Russian EEZ in South-Eastern Baltic in 2015. Gammarid *Chaetogammarus warpachowsky and* mysid *Limnomysis benedini,* introduced intentionally long ago, in 1960s, were firstly recorded in the new geographic location of Russian SEB, starting range expansion since 2014–2015.

Well established earlier recorded NIS *Neogobius melanostomus, Rangia cuneata, Marenzelleria neglecta, Eriocheir sinensis, Rhithropanopeus harrisii, Cercopagis pengoi, Gamamrus tigrinus, Pontogammarus robustoides, Obesogammarus crassus* are constantly recording in Russian SEB and have a leading position in the communities.

Re-identification of materials of 2001–2015 from off-shore marine areas of Russian SEB let to conclude that polychaete of *Marenzelleria genus,* usually identified as *Marenzelleria neglecta,* belong to other species - *Marenzelleria arctia*, never before not reported for Russian EEZ. Thus, *Marenzelleria arctia* is dwelling in marine habitats, but the Vistula Lagoon is inhabited by other species, *Marenzelleria neglecta*.

Bivalve *Rangia cuneata,* reported in 2013 from off-shore area of Russian SEB, can't establish and disappeared in 2014/2015. Field observation show the increase of frequency and range of distribution of several Ponto-Caspian aliens in 2014–2015. No new published records of alien species in the Gulf of Finland and the Black Sea areas.

1. Regulations

In 2014/2015 any new national regulations didn't appear. Russian Federation joined to IMO BWMC on 28 March 2012.

2. Intentional

No intentional introduction of species regarded as alien, has been reported.

Deliberate releases were conducted for two species: 1. whitefish (*Coregonus lavaretus*) – 150 thous. in 2014, 196 thous. in 2015; pike (*Esox lucius*) 2 132 thous. (data of Zapbaltrybvod, Agency of fishery, Kaliningrad).

In Russian part of the Curonian Lagoon sturgeon fry (*Acipenser oxyrhynchus oxyrhynchus*), released in Lithuania, Sventoji, Nemunas and Neris rivers in frame of international project, concentrated mostly, probably, due to better food condition. In 2011–2013 5 thousands were released in Lithuania, data for 2014 and 2015 unavailable. In the Russian part of Curonian Lagoon 34 findings were documented in 2012–2013 (Kolman *et al.*, 2012; Gushchin *et al.*, 2013). 31 – 2014 (Gustchin at al., 2014), 32 – 2015 (AB IORAS unpubl.) In the Gulf of Finland - 300–400 thous. of atlantic salmon (*Salmo salar*), 1–2 year specimens, from Luga, Narva and Nevskyi fish factories (information from GosNIIORH, S.-Peteburg).

In the Black and Sea of Azov basin:

2 species of sturgeons (*Acipenser gueldenstaedtii, Acipenser ruthenus*), totally 6 800 000 ind. (5 fish factories) (Report of AzCherNIRO, 2015)

3. Unintentional

New Sighting

Polychaetes. Four new polychaete species could be regarded as NIS: Sabellid polychaetes *Laonoma calida* (?) was recorded first time for the Vistula Lagoon (Baltic Sea) in 2015, retrospective analysis detected its presence in the area since June 2014.

Other sabellid *Aracia heterobranchiata* (?) was recorded in the deltaic region of the Don River (Sea of Azov), also in 2014. Two more alien polychaete species, belonging to the genus *Marenzelleria,* were collected in the Don River estuary and the Taganrog bay (Sea of Azov) in 2014. Most probable vector for all four – ballast water, all species demonstrated signs of reproduction in the new areas. Taxonomic position of all 4 species is under consideration now

Gammarids. Gammarid*s Dikerogammarus vilosus and Dikerogammarus haemobaphes*- other two species, recorded firstly for the Russian marine areas of South-Eastern Baltic in 2015.

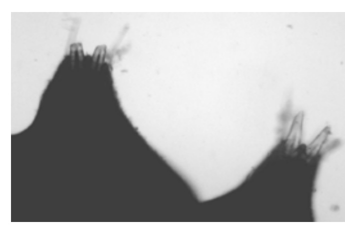
Southeastern Baltic Sea

Gammarids. *D. haemobaphes* and *D. villosus* are very relative species of Ponth-Caspian origin, rather similar in morphology. *D. haemobaphes* is currently recording in the lagoon environment (Russian part of Vistula Lagoon) since 1998–1999 (Ezhova *et al.*, 2005) but was never marked in the marine coastal zone of Russian SEB and in South-Eastern Baltic in whole. D. *vilosus* was reported in the early 2000s from the Visla River deltaic region, but any records of this species in the Lagoon were not published. Recently, in August 2010 *D. villosus* was recorded in the Gdansk Bay, near the mouth of the Vistula River (Dobrzycka-Krahel, Rzemykowska, 2010), and in the Polish part of the Vistula Lagoon – in May 2011 (Dobrzycka-Krahel *et al.*, 2015). In the Russian part of the Vistula Lagoon in 2015 or earlier the species didn't marked.

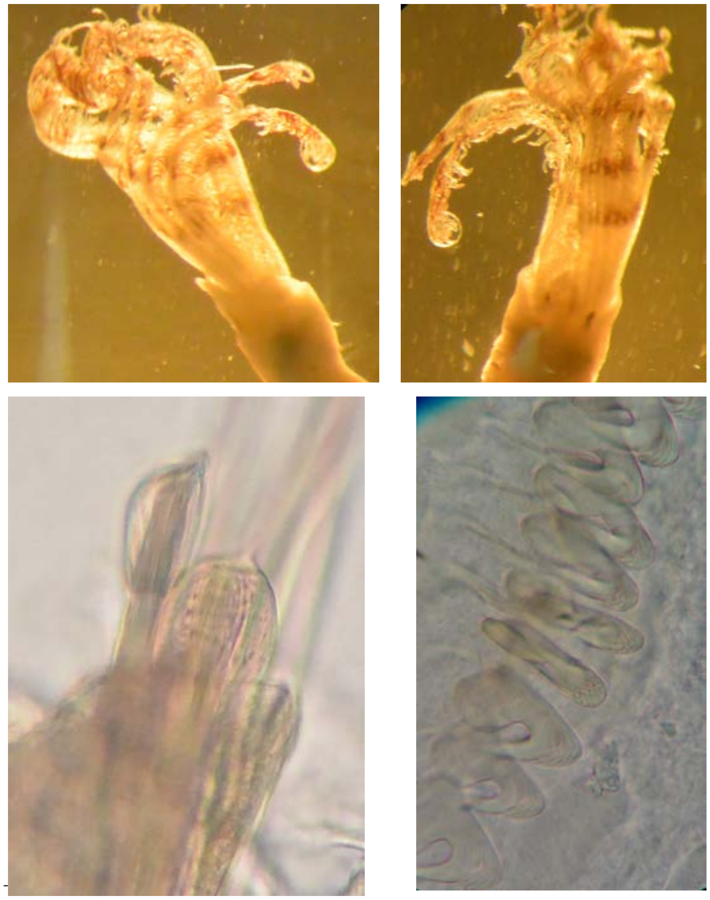
Dikerogammaris villosus was recorded for the first time in Russian SEB area, as a single finding, when sampling hand net near port Baltiysk in the South-Eastern part of the Baltic Sea, Gdansk Bay, (54 º 38.364 ' N, 19° 52.545 ' E). Detail of record: June 21, 2015 male (22.7 mm, 154 mg WW) and female (18.3 mm, 126 mg WW) (Gusev *et al.* in print). Probable pathway of *D. villosus* distribution in Eastern and Central Europe - Central invasive corridor (Dnepr - Pripyat -Dnieper-Bug-Canal- Narew-Vistula) (Konopacka, 2004; Bącela *et al.*, 2008; Semenchenko *et al.*, 2009). Dispersal could start after introduction of *Dikerogammaris villosus* into the Kiev reservoir in 1950–1955 (Karpevich, 1975). The appearance of the species in the Russian aquatory of the Gdansk Bay look like as secondary dispersal by natural vectors from the Polish coastal area

Dikerogammarus haemobaphes In marine habitats was found firstly in February 2015 in marine algal supra-littoral debris at the north coast of the Sambian Peninsula. Analysis of previous samples (2013/2014) from littoral algal beds has shown a constant presence of *D. haemobaphes* and rather rare (not higher 13 %) – admixture of *D. villosus* since summer 2013. Gravid females were found for both species. Data on occurrence points out that both species were present in the marine littoral zone in 2013, but *D. haemopbaphes* was already well established, while *D. villosus* only start to appear from south-western direction. (Molchanova, Ezhova, in print) .Vectors and pathways of distribution need to be studied.

Details of *Dikerogammarus haemobaphes* and *Dikerogammarus vilosus* morphology by N. Molchanova (AB IORAS)

Species	Body view, male	Details of morphology (spines of urosome)
Dikerogammarus haemobaphes		 2+2
Dikerogammarus vilosus		 4 (3 and >)+ 4(3 and >)

Laonome calida Capa, 2007 Alien polychaete worm of Sabellidae family was recorded for the first time in the Vistula Lagoon, Baltic Sea, in the vicinity of Marine Ship Channel in 2015. The species was identified as *Laonome calida* Capa, 2007. The recent invasion of very relative *Laonome sp*..was reported from the Gulf of Riga, Pärnu Bay, but the species is treated as a species nova, thus finding *L. calida* in the Vistula Lagoon is the first registration of species in the Baltic Sea. Originally feather-duster worm *L. calida* was described from coastal waters of Western Australia. In Europe first record of worm – Netherlands inland waters, North Sea, 2009.

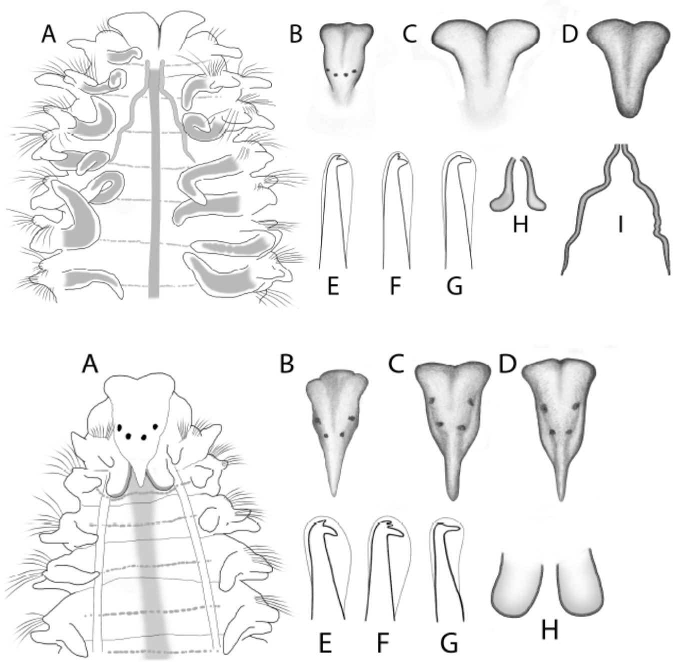


Details of morphology of Laonoma species, new for Russian SEBaltic area and the South-Eastern Baltic in whole. Photo O. Kocheshkova (AB IORAS, unpubl.)

A new alien polychaete was marked on 3 monitoring sites in June 2014, July and October 2015. Previous surveys didn't record *L.calida*, it let to suppose beginning 2014 as the time of introduction. At the territorial sea the species was not marked (Ezhova *et al.*, in print) Kotta *et al.*, 2015 describe the abundance of alien *Laonoma sp.* as rather high (752 ind m^{-2}) at station adjacent to Pärnu rivermouth and much lower abundances of around 50–100 ind m^{-2} in other location. In the Vistula Lagoon the abundance of Laonoma didn't exceed 200 ind. m^{-2}

Sea of Azov

***Marenzelleria sp,1* and *sp.2* (Polychaeta, Spionidae)**. During the monitoring investigations in the Don River estuary and the Taganrog bay, two alien polychaete species of the genus *Marenzelleria* Mesnil, 1896 (fam. Spionidae) were recorded. Adult specimens were collected in March – April and November 2014. Also, high abundances of spionid nectochaetes supposedly belonging to these species were recorded in February 2014 in the Taganrog bay. Descriptions of present adult and larval specimens are given, and two morphological groups are distinguished, followed by the discussion of their identity and possible results of their settling. Probable way of their penetration is transferring of pelagic larval stages from the Baltic or North seas in ballast water tanks, for many tankers use to spill their ballast waters in this area (Syomin *et al.*, 2016) http://www.sevin.ru/invasjour/issues/2016_1/Syomin_16_1.pdf



Details of morphology of *Marenzelleria sp.* 1 and *Marenzelleria sp.*2 (From Syomin *et al.*, 2016)

Aracia sp. (Polychaeta: Sabellidae) During the monitoring investigations in the Don River estuary, an alien polychaete species of the family Sabellidae was recorded. Polychaete specimens were collected two times with a month interval, and in the later sample one specimen had eggs in anterior abdominal chaetigers. The description of present specimens is provided. All the specimens match the diagnosis of the genus *Aracia* Nogueira, Fitzhugh et Rossi, 2010. However, there is an uncertainty at the species level: both *A. riwo* and *A. heterobranchiata* characters are present, though the latter seems to be more likely. Probable way of penetration is ballast water tanks, for many tankers use to spill their ballast water in this area (Syomin *et al.*, 2016) http://www.sevin.ru/invasjour/issues/2014_4/Syomin_14_4.pdf

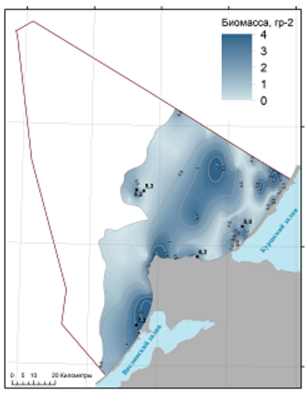
Previous Sightings

SE Baltic Sea

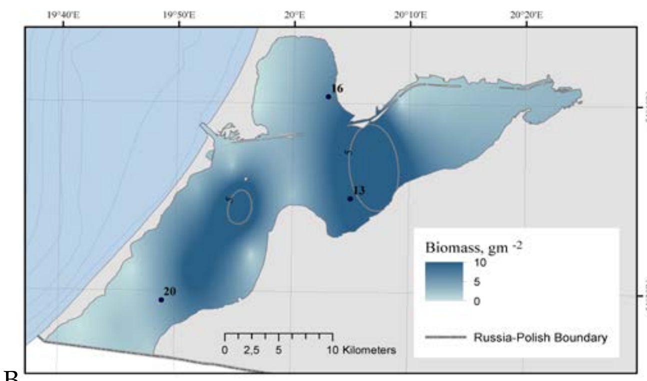
Rangia cuneata (G.B.Sowerby I, 1831) (Bivalvia: Mactridae) was recorded firstly for the Baltic Sea in the Vistula lagoon, September 2010 as newly settled juveniles (Rudinskaya, Gusev, 2012), now it is represented by a fully established population, main dominant species of the lagoon. In July 2013 *R. cuneata* was firstly recorded in marine environment of Russian SEB near Russian-Lithuanian border (Gusev & Rudinskaya, 2014)

In September 2013 living specimens of rangia disappeared, dead shells were present (Gusev, pers. comm.). In May-June 2014 any signs of rangia presence were absent (Ezhova, field data). Larvae of R.cuneata, were marked in the shallow sea water close to the Balltijsk Strait, summer 2015

Marenzelleria arctia, Re-identification of AB IORAS polychaete collection (2001–2015) from off-shore marine areas of Russian SEB let to conclude, polychaete *Marencelleria arctia* is dwelling in marine habitats, while in the Vistula Lagoon environment *Marenzelleria neglecta* occurs. Biomass of *M. arctia* is very low 1.2 g m^{-1} WW in average. *M.neglecta* dwelling in the lagoon, is more abundant (Figs A, B)



A



B

Distribution of Marenzelleria arctia (A) and Marenzelleria neglecta (B) biomass in Russian SEB, data averaged for 2001–2014 and 2001–2012 respectively (compiled by O.Kocheshkova, AB IORAS, unpubl.).

Gulf of Finland

No new introductions published or reported. Review of alien fish fauna is published (Popov, 2014).

Marenzelleria arctia, arctic species of spionid polychaete, invaded Gulf of Finland in 2009, defined mass development of deep-water benthos and due to high abundance and level of bioturbation activity, changed totally chemical-physical features in upper bottom layer, leading to sufficient changes in matter turnover (*Maximov et al. 2014, 2015, 2016, Voloshchuk et al. 2015*). In the Russian part of the Gulf of Finland invasion of polychaetes of *Marenzelleria* genus was recorded in 1996, but till 2009 alien polychaete did not cause the pronounced changes in the bottom communities, its high biomass was occurred in the shallow, above-termocline areas and was defined by *M. neglecta* . Since 2009, other species of the genus, *M. arctia* occupied deep-water areas in the Gulf of Finland.

The changes in the concentrations of the mineral nitrogen (nitrates and nitrites) and phosphorus and in the state of the planktic communities in the eastern Gulf of Finland following a large-scale invasion of the polychaete *Marenzelleria arctia* were analyzed. The bioirrigation and bioturbation of the bottom deposits by polychaetes resulted in a dramatic increase in the nitrogen/phosphorus ratio in the waters of the gulf, thus lead-ing to cascade changes in the plankton. As a result of the decrease in the abundance of colonial nitrogen-fixing cyanobacteria, which cause “blooming” in surface waters, the total biomass of the phytoplankton and chloro-phyll *a* concentration decreased. Because of the disappearance of large colonies of cyanobacteria and the surge of small algae, the food supply for the zooplankton improved and its biomass increased. According to our calculations, the amount of phosphorus deposited in the bottom sediments as a result of the polychaete activity markedly exceeded the external phosphorus load on the Gulf of Finland from the Russian coast. We conclude that the invasion of *Marenzelleria arctia* resulted in the cardinal reconstruction of the entire ecosystem of the eastern Gulf of Finland. (Maximov *et al.*, 2014) DOI: 10.1134/S0001437013060052).

Marenzelleria spp. are among the most successful non-native benthic species in the Baltic Sea. These burrowing polychaetes dig deeper than most native Baltic species, performing previously lacking ecosystem functions. We examine evidence from experiments, field sampling and modelling that the introduction of *Marenzelleria spp*. affects nutrient cycling and biogeo-chemical processes at the sediment—water interface. Over longer time scales, bioirrigation by *Marenzelleria spp*. has the potential to increase phosphorus retention in bottom deposits because of deeper oxygen penetration into sediments and formation of a deeper oxidized layer. In contrast, nitrogen fluxes from the sediment increase. As a consequence of a decline of the phosphate concentration and/or rising nitrogen/phosphorus ratio, some Northern Baltic ecosys-tems may experience improvement of the environment because of mitigation of eutrophication and harmful cyanobacteria blooms. Although it is difficult to unambiguously estimate the ecosystem-level consequences of invasion, in many cases it could be considered as positive due to increased structural and functional diversity. The long-term interactions with the native fauna still remain unknown, however, and in this paper we highlight the major knowledge gaps. (Maximov *et al.*, 2015) http://www.sciencedirect.com/science/article/pii/S0078323415000871

Results of recent observations of alien fish species (anchovy, piranha, Chinese sleeper, rainbow trout, and peled) in water bodies around Saint-Petersburg (Gulf of Finland, Ladoga Lake and surrounding rivers and lakes) are presented. Relatively new species, i. e. the species increasing their distribution area recently (sabrefish, zope, sprat), are discussed as well. The causes of such events are discussed. The fishing and overfishing of local fishes are considered as the most significant ones (Popov, 2014). Most new registration of alien fish in this review - *Plecottus glenii* (2013)
http://www.sevin.ru/invasjour/issues/2014_1/Popov_14_1.pdf

Sea of Azov

Alien fish. There are nine alien species in the region of the study. The distribution and abundance of non-native fish in the reservoirs of northwestern part of the Azov Sea basin depends on the scale of the fishery activities, the degree of transformation of hydro ecosystems, water release into the rivers from irrigation canals. There are three groups of species registered according to the number indices in the waters of the basin. The first is the species the findings of which are rare in the region; the second group comprises fish, the number of which depends on fishery activities; and the third one embraces the species that are high in number and their self-reproducing populations exist. (Demchenko, Demchenko, 2015)
http://www.sevin.ru/invasjour/issues/2015_1/Demchenko_15_1.pdf

Information on the spreading of alien fish species along the main waterways in the waterbodies of Vologda Region is summarized. The role of the Volga-Baltic waterway and North-Dvina water system in invasion of fish in the basins of the Caspian, White and Baltic seas are evaluated. Materials on invasion of fish through the main water systems within the boundaries of three basins of the seas and fish penetration across these boundaries have been analyzed (Konovalov *et al.*, 2015)

4. Pathogens

In *Larus canus* and *L. minutus* parasite *Apophallus müehlingi* (Jägerskiöld, 1899) Lühe, 1909 (Trematoda, Heterophyidae) was found in 2014, but also in 2012–2013 in Lake Ladoga. Mature *A. müehlingi* were registered only in those species of gulls in the spring, immediately after their returning from the wintering areas. Detection of the parasite indicates a potential environmental threat. *A. müehlingi* is revealed only in definitive host at the present time. However, the penetration of gastropods *Lithoglyphus naticoides* Pfeiffer, 1828, the parasite's first intermediate host, into Lake Ladoga will form conditions for the realization of the life cycle of the parasite. This can lead to the *A. müehlingi* epizooty of fish. (Yakovleva *et al.* 2016)

http://www.sevin.ru/invasjour/issues/2016_1/Yakovleva_16_1.pdf

5. Meetings

Meeting and conferences aimed only to NIS problem did't took place in 2014 and 2015. The programm of several large all-Russian conference have include specific section in regard of NIS thematic.

- XI Congress of Hydrobiological society of RAS (22–26 September 2014, Krasnoyarsk, Russia)

- 5th International Scientific Conference to commemorate famous hydrobiologist G.G. Winberg (12–17 October 2015, St. Petersburg, Russia).

Reports

2014

Rudinskaya L, Gusev, A., Naumenko E. The Influence of large-scale invasions on the benthic community structure in the Vistula Lagoon. XI Congress of Hydrobiological society of RAS (22–26 September 2014, Krasnoyarsk, Russia). Abstr. of Rep. Sib. Univers., 2014. S. 141–142.

Gusev A.A., Rudinskaya L.V., Aleksandrov S.V. Energy budget model of the wedge clam *Rangia cuneata* in the Vistula Lagoon of the SE Baltic Sea // 54th Estuarine and Coastal Sciences Association international symposium "Coastal systems under change: tuning assessment tools", (12–16 May 2014, Sesimbra, Portugal). Sesimbra: 2014. P. 103–104.

Rudinskaya L.V., Gusev A.A., Aleksandrov S.V., Semenova A.S. The impact of recent large-scale invasions on structure of the benthic community in the open part of the Vistula Lagoon in 1985–2013 // 12th international CONFERENCE Littoral 2014 "Facing present and future coast challenges", (22–26 September 2014, Klaipeda, Lithuania). Klaipeda: 2014. P. 130.

Semenova A., Dmitrieva O., Gusev A., Aleksandrov S. Changing in plankton community of the Vistula Lagoon (Baltic Sea) after *Rangia cuneata* (Sowerby I, 1832) invasion // 12th international CONFERENCE Littoral 2014 "Facing present and future coast challenges", (22–26 September 2014, Klaipeda, Lithuania). Klaipeda: 2014. P. 133.

2015

Gusev A., Rudinskaya L., Aleksandrov S. Morphometric relationships of *Rangia cuneata* in the Vistula Lagoon (Baltic Sea) // 10th Baltic Sea Science Congress "Science and innovation for future of the Baltic and the European regional seas", (15–19 June 2015, Riga, Latvia). Riga: 2015. P. 194.

Gusev A.A., Rudinskaya L.V. Production characteristics of the invasive bivalve *Rangia cuneata* (G.B. Sowerby I, 1832) in the Vistula Lagoon (Baltic Sea) // 5th International Scientific Conference to commemorate famous hydrobiologist G.G. Winberg (12–17 October 2015, St. Petersburg, Russia). St. Petersburg: P. 92.

Lange E. Invasion of cyanobacterium *Planktolyngbya brevicellularis* Cronb. et Kom. into the Curonian lagoon (Baltic Sea) in 2000s //Abstract book of the 10th Baltic Sea Science Congress 15–19 June, 2015 Riga, Latvia. – Riga, 2015. – P. 202.

Naumenko E.N., Rudinskaya L.V., Gusev A.A. Invasive species in planktonic and benthic communities of the Vistula Lagoon of the Baltic Sea // 5th International Scientific Conference to commemorate famous hydrobiologist G.G. Winberg (12–17 October 2015, St. Petersburg, Russia). St. Petersburg: P. 180.

6. References and bibliography:

Demchenko V.A., Demchenko N.A. Alien species in the ichthyofauna of north-western part of the Azov Sea basin. Russian Journal of Biological Invasion, 2015, № 1: 17–29

E. V. Voloshchuk, T. R. Eremina, V. A. Ryabchenko Modeling of biogeochemical processes in the sediments of the eastern part of the Gulf of Finland by means of diagenetic model. Theoret. and applied hydrophysics. 2015. v.8, №4, p. 106–113.

Ezhova E, Kocheshkova O., Molchanova N. First record of feather-duster worm *Laonome calida* Capa 2007 (Annelida: Sabellidae) in the Baltic Sea. Russian Journal of Biological Invasion (*in print*)

Ezhova E., Kocheshkova O., Polunina J., Molchanova N. Alien invertebrate fauna of the Russian part of South-Eastern Baltic Sea. Environment of the Kaliningrad region of Russian Federation: v. 1 , Baltic Sea. Shpringer (in print)

Gusev A., Sudnik S., Guseva D. New registration of Ponto-Caspian gammarid *Dikerogammarus villosus* (Sowinsky, 1894) in the southeastern part of the Baltic Sea (Kaliningrad, Russia). Russian Journal of Biological Invasion (*in print*)

Gushchin A., Kolman R., Lysanskij I. 2015. Monitoring catches of atlantic sturgeon, *Acipenser oxyrinchus* Mitchel, fry in the Russian part of the Curonian lagoon // Komunicaty Rybacki, 4: 14–16.

Konovalov A.F., Borisov M.Ya., Bolotova N.L. Expansion of alien fish species through the main waterways in the waterbodies of Vologda Region. Russian Journal of Biological Invasion, 2015, № 2 : 53–66.

Konovalov A.F., Borisov M.Ya., Bolotova N.L. Expansion of alien fish species through the main waterways in the waterbodies of Vologda Region**.** Russian Journal of Biological Invasion, 2015, № 2: 53–66.

Maximov A., Bonsdorff E., EreminaT., Kaupp L., Norkko A, Norkko J. Context-dependent consequences of Marenzelleria spp. (Spionidae: Polychaeta) invasion for nutrient cycling in the Northern Baltic Sea, Oceanologia (2015) 57, 342—348.

Molchanova N.S., Ezhova E.E. On distribution of two Ponto-Caspian gammarids of *Dikerogammarus* genus in the littoral zone of South-Eastern Baltic Sea (Russian EEZ). Sent to: Russian Journal of Marine Biology.

Naumenko E., Rudinskaya L. Gusev A. The influence of invasive species on the structure of the zooplankton and zoobenthos in the Vistula Lagoon Baltic Sea. *Regional Ecology*, Russian Academy of Sciences. 2014. №1–2 (35). S. 21–28.

Syomin V.L., Kovalenko E.P., Savikin A.I. *Aracia* sp. (Polychaeta: Sabellidae) from the Don River estuary (the Sea of Azov basin). Russian Journal of Biological Invasion, 2014, № 4: 97–101 .

Syomin V.L., Sikorski A.V., Kovalenko E.P., Bulysheva N.I. Penetration of genus *Marenzelleria* (Polychaeta: Spionidae) into the Don River estuary and the Taganrog bay. Russian Journal of Biological Invasion, 2016, № 1: 109–120.

Yakovleva G.A., Lebedeva D.I., Ieshko E.P. The first finding of *Apophallus müehlingi* (Jägerskiöld, 1899) Lühe, 1909 (Trematoda, Heterophyidae) in Karelia. Russian Journal of Biological Invasions 2016, № 1: 147–154.

Sweden

Prepared by Ann-Britt Florin with contributions from: Cathy Hill, Matz Berggren, Hedvig Hogfors, Johan Wagnström, Mora Aronsson, Kristin Dahlgren, Åsa Strand, Lena Kautsky, Caroline Raymond, Peter Göransson, Vidar Öresland, Sofia Brockmark and Erland Lettevall

Overview

No new nonindigenous species have been discovered in 2015 but it was revealed that the polychaeta *Boccardiella ligerica* was first discovered in Sweden in 2013. There have been some new reports of American lobster *Homarus americanus* in Kattegat/Skagerrak including egg bearing females and the round goby *Neogobius melanostomus* continue ist spread and incerase in density in the Baltic Sea.

Content:

1. Regulations and policies

Several new actions have been undertaken by the Swedish Agency of Marine and Water Management (SwAM):

- A proposal of new a Swedish regulation implementing the EU regulation (1143/2014) on the prevention and management of the introduction and spread of invasive alien species regulation, laid down by the Swedish Environmental Protection Agency (SEPA) with support by SwAM.
- An update and additional information on alien species on SwAM webpages, replacing the old web site on alien species in Swedish seas and coastal areas (www.frammandearter.se)
- Risk assessment for American lobster (*Homarus americanus*), Swedish Agency for Marine and Water Management report 2016:4
- Information campaign targeting in recreational fishermen in order to increase reporting of live *Homarus americanus*.

- A new action program for MSFD including suggested actions against invasive species was published in December 2015 (Havs- och vattenmyndigheten, 2015).

2. Intentional

No information

3. Unintentional

New Sightings

The polychaetae *Boccardiella ligerica* was first discovered in Sweden in 2013 in southern Bothnian Sea. The discovery was made in the environmental monitoring of benthos in the nuclear power plant surveillance program (Adill *et al.* 2015).

Two new species of the cirratulid genus Tharyx have been reported from shallow waters in the Kattegat inshore Sweden: *T. maryae* and *T. robustus* (Blake & Göransson 2015). The status of these species, cryptogenic or nonindigenous, is not known.

Previous Sightings

No information

Range expansions

The Japanese shore crab *Hemigrapsus sanguineus* (De Haan 1835), was first observed in Sweden in 2012 close to Gothenburg in the border between Kattegat and Skagerrak (Berggren 2013). On the 5th of September in 2014 a second individual of this Asian crab was found in Ustö, Kattegat, 50km south of the first location (Jansson *et al.* 2015, http://www.artportalen.se/Sighting/16900218,). In august 2015 two new sightings were made, one close to Gothenburg and one in Hakefjoren 30 km north of Gothenburg (Matz Berggren, University of Gothenburg(GU), pers. comm). All sightings in the Gothenburg area probably result from ballast water of ships entering the harbour of Gothenburg. However, if and when the species will be sighted further north on the coast, around the Smögen area, it will pprobably be a case of secondary spread by water currents from France/Belgium/Holland where the species is established. At Helgoland in the German Bight, that is even closer and in the start of the Jutland current, ovigerous females have been caught.

Despite the massive mortality of pacific oyster (*Crassostera gigas*) caused by the herpes virus OsHV-1 µvar in the autumn 2014 (Mortensson *et al.* 2016) the pacific oysters have increased in density and also increased their distribution range with sightings even down to the Öresund (Åsa Strand, GU pers. com). Several studies have been on impact of the Pacific Oyster have been published during the last year (Laugen *et al.* 2015, Norling *et al.* 2015 and Hollander *et al.* 2015).

During 2015, 4 new American lobsters, *Homarus americanus,* whereof 1 egg bearing females were found in Skagerrak. All have been confirmed by genetic analysis to be *Homarus americanus*; and the eggs were not hybrids (Vidar Öresland, Swedish University of Agricultural Sciences (SLU) pers. comm.). This means that in total 32 American lobsters have been verified in Sweden. Their origin is probably escapees from the food industry holding live specimens.

Round Goby, *Neogobius melanostomus,* is continuing expanding its range in the Baltic Sea. In 2015 several more localities were found, mainly at or south of the sound between the island of Öland and the Swedish east coast. In addition, the one new findings at Gotland and the outer part of Bråviken bay was reported. Occurrences are logged in the Species Observation System for citizen science (Artportalen, www.artportalen.se and also presented at www.slu.se/svartmunnadsmorbult. Monitory fishing conducted by SLUin southern Stockholm archipelago show a 30-fold increase in catch per unit effort in 2015 compared to 2014 and in county of Blekinge twice as much round goby was caught in 2015 compared to 2014 (http://www.slu.se/en/departments/aquatic-resources/databases/database-for-coastal-fish-kul/) .

4. Pathogens

No information

5. Meetings

The Scandinavian Oyster network arranged two meetings regarding Pacific oyster targeting managers in Denmark, Sweden and Norway: 20/1 2015, Bergen, Norge: Workshop: en Skandinavisk modell for overvåking og forvaltning av stillehavsøsters, Crassostrea gigas? and 27/2 2015, Köpenhamn, Danmark: Meeting on management and monitoring of invasive species in Nordic countries, with special focus on the Pacific Oyster, *Crassostrea gigas*.

The University of Gothenburg arranged a workshop on niche modelling of invasive species using the SwedishLifeWatch/BioVeL platform 10–12/6 2015, Sven Lovén Center for Marine Sciences, Tjärnö, Sweden. Specific aims were: 1) learning how to use the BioVel platform (http://www.svenskalifewatch.se/en/tools/) for Ecological Niche Modelling; and 2) initiating collaborative work on two case studies of invasive species: climate-related changes in spread and competition between three ecologically dominant species complexes (Crassostrea, Mytilus, Ostrea) and prediction of current suitable habitat for the invasive, toxin-producing cyanobacterium *Cylindrospermopsis raciborskii* to determine hotspots for near-future monitoring efforts.

The goby meeting 2015. Gobies as a model for invasion biology, climate effects and reproductive strategies. A Marcus Wallenberg symposium. Held in Umeå 24–27 February 2015.
SwAM and SEPA held several information meetings in the autumn targeting the new EU regulation (1143/2014) on the prevention and management of the introduction and spread of invasive alien species regulation. Participants: relevant authorities, experts, NGO, stakeholders, etc.

SWAM arranged a workshop (14–15 of October) aimed for relevant agencies and experts targeting the Marine Directive (monitoring, indicators, assessment, etc.).

6. Other

Swedish records in the AquaNIS database was updated during 2015 (Ann-Britt Florin, SLU, pers. comm.)

During 2015 SwAM, the County board of Värmland and University of Gothenburg launched a pilotproject for developing a webbased reporting system for crowdsourcing "Rappen" (https://filemaker-08.it.gu.se/fmi/webd?homeurl=https://www.havochvatten.se/hav/uppdrag--kontakt/kontakta-oss/hav-i-sociala-medier/rappen.html#rappenv2). It enabled reports on the web as well as on smartphones or tabloids and included both threatened and invasive alien species. A new project is planned for 2016 to further develop the reporting system and campaigns for encouraging citizen science specifically for alien species.

Two scientific projects coordinated by AquaBiota Water Research and financed by the SEPA and SwAM with an impact on non-indigenous species were conducted in 2015: NISSES and VALUES (Hedvig Hogfors och Antonia Nyström Sandman AquaBiota Water Reserach, Erland Lettevall SwAM, pers. comm).The project Non-Indigenous Species in Swedish seas (NISSSES) 2014–2016 aims to development indicators for good environmental status regarding marine non-indigenous species in Sweden. In VALUES a case study of the effects of *Marenzelleria* spp on the link between benthic and pelagic ecosystem and the possible consequences of the species on the flow of phosphorus to the water is included (Hedvig Hogfors och Antonia Nyström Sandman AquaBiota, Erland Lettevall SWAM, pers. comm.)

Barcodes have been developed for *Mytilopsis leucophaeata* using samples from Sweden

http://www.barcodinglife.org/index.php/Public_RecordView?processid=OZIMP032–15

http://www.barcodinglife.org/index.php/Public_RecordView?processid=OZIMP033–15

7. References and bibliography

Adill, A., Heimbrand, Y., Mo, K., Bergström, L. (2015). Undersökning av hårdbottenfauna vid Forsmarks kärnkraftverk - Metodikutveckling av artificiella substrat för övervakning av bottenfaunasamhällen på områden som saknar sediment. Aqua reports 2015:10. Sveriges lantbruksuniversitet, Öregrund. 35 s. (in Swedish) www.slu.se/aquareports.

Berggren M. (2013). Nya fynd av kräftdjur vid den svenska västkusten. Fauna och Flora 108(3):42–44.

Blake, J.A. Göransson P. 2015. Redescription of *Tharyx killariensis* (Southern) from Ireland and description of two new species of Tharyx from the Kattegat, Sweden (Polychaeta, Cirratulidae). Zootaxa 4039 (4): 501–515.

Jansson M., Fagerholm B., Wernbo A. (2015). Biologisk recipientkontroll vid Ringhals kärnkraftverk. Årsrapport för 2014. Aqua reports 2015:5 Sveriges lantbruksuniversitet. (in Swedish) www.slu.se/aquareports.

Laugen, A., Hollander, J., Obst, M., Strand, Å. (2015). The Pacific Oyster (*Crassostrea gigas*) invasion in Scandinavian coastal waters in a changing climate: impact on local ecosystem services. In Clode, J.C. (Ed.) Biological Invasions in Changing Ecosystems-Vectors, Ecological Impacts, Management and Predictions. De Gruyter Open, Berlin. Pp. 230–252.

Norling, P., Lindegarth, M., Lindegarth, S., Strand, Å. (2015). Effects of live and post-mortem shell structures of invasive Pacific oysters and native blue mussels on macrofauna and fish. MEPS, 518: 123–138.

Havs och vattenmyndigheten (2015). God havsmiljö 2020. Marin strategi för Nordsjön och Östersjön. Del 4: Åtgärdsprogram för havsmiljön. Havs- och vattenmyndighetens rapport 2015:30 (Swedish Agency for Marine and Water Management). https://www.havochvatten.se/download/18.45ea34fb151f3b238d8d1217/1452867739810/rapport-2015–30-atgardsprogram-for-havsmiljon.pdf (accessed 2016–03–16).

Hollander, J., Blomfeldt, J., Carlsson, P., Strand, Å. (2015). Effects of the alien Pacific oyster (*Crassostrea gigas*) on subtidal macrozoobenthos communities. Marine Biology, 162:547–555.

Stein Mortensen, Åsa Strand, Torjan Bodvin, Anders Alfjorden, Cecilie K. Skår, Anders Jelmert, Anna Aspán, Lisbeth Sælemyr, Lars-Johan Naustvoll, Jon Albretsen (2016). Summer mortalities and detection of ostreid herpesvirus microvariant in Pacific oyster Crassostrea gigas in Sweden and Norway. DISEASES OF AQUATIC ORGANISMS. Vol. 117: 171–176, 2016, doi: 10.3354/dao02944.

United Kingdom

Compiled by Gordon H. Copp (Cefas), Hannah Tidbury (Cefas), Paul Stebbing (Cefas) and Lyndsay Brown (Marine Scotland), with contributions from Jill Barbour (Marine Scotland); Elizabeth Cook (Scottish Association for Marine Science); Michael Gubbins (Cefas); Jenni Kakkonen (Orkney Islands Council Marine Services); Tracy McCollin (Marine Scotland) and Chris Nall (Environmental Research Institute)

Highlights

Various monitoring exercises and biosecurity projects have been completed during 2014 by institutions throughout the UK. These include a published biosecurity Plan developed for the Shetland Isles that provides supplementary guidance to the Shetland Islands' Marine Spatial Plan. Scottish Natural Heritage published guidance for preparing a non-native species biosecurity plan for sites/operations. The Environmental Research Institute published results from a rapid assessment of marinas and harbours for marine non-native species as well as a study on biofouling of commercial vessels. The Marine Biological Association has conducted a number of studies assessing the distribution of non-native species in English and Welsh marinas using rapid assessments. Data gathered have been compared to previous similar studies to assess spread.

Cefas has developed and trialled molecular tools and techniques by which to detect the presence of NNS from the DNA found in environmental samples (e.g. scrape, sediment, water). Cefas has also been using environmental DNA (eDNA) analysis to detect specific non-native species such as the warty comb jellyfish (a.k.a sea walnut) *Mnemiopsis leidyi* and, in collaboration with Bournemouth University, four freshwater fish species (topmouth gudgeon *Pseudorasbora parva*, sunbleak *Leucaspius delineatus*, pumpkinseed *Lepomis gibbosus*, fathead minnow *Pimephales promelas*). This work includes the use of eDNA to assess the efficacy of invasive species eradications. Cefas is also developing a method using molecular information on populations of NNS present in the UK, along with information regarding the potential pathways by which these species could have been introduced and spread, to determine from where the populations originated and the nature of their introduction. Cefas and the University of Leeds have conducted a number of studies examining the use of hot water as a biosecurity tools in the freshwater environment, with a range of invasive plant and inverterbrate species tested. Results of these studies indicate that a water of temperature of 40°C may be effective for the invasive plants and invertetrates. Additionally, a fact-finding exercise was undertaken in New Zealand to assess how the awareness and up-take of the biosecurity programme 'Check, Clean, Dry' has been maintained for over a decade. Cefas has undertaken preliminary assessments of chemical control agents delivered through a spiked-bait feeding station system in the control of signal crayfish (*Pacifastacus leniusculus*) and killer shrimp (*Dikerogammarus villosus*).

Cefas has continued to co-ordinate the Marine Pathways Project. The project has had contributions from a number of organisations from across the UK and Republic of Ireland. Work conducted by the project has included the assessment of high risk location of introduction, the development of biosecurity advise for stakeholders, the development of monitoring and surveillance programmes and tools, including assessing the distribution of certain marine non-native species, in addition to examining control measures for certain marine invasive species. The Marine Pathways Project officially ended in March 2015. Nonetheless, the Marine Pathways group continues, with support from Defra (co-ordinated by Cefas), to act as an expert steering group, sharing knowledge and experience and providing advice on the subject of marine NIS to inform Policy and management.

Cefas has continued to investigate methods of controlling invasive species of crayfish, with a 2.5 year trapping study, which is due to end in March 2015, Cefas has developed a new aquatic invasive species screening tool (Aquatic Species Invasiness Screening Kit (AS-ISK). This is now available (https://www.cefas.co.uk/services/research-advice-and-consultancy/invasive-and-non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/) and is currently being validated and trailled in assessments of a range of freshwater, brackish and marine species, including multiple assessments of the Manila clam *Venerupis philippinarum* by several risk assessors for different risk assessment areas world-wide.

Cefas is currently developing a NNS monitoring and surveillance programme to cover the UK. Expected to be implemented from April 2016, this is based on the incorporation of NNS reporting into existing statutory marine monitoring programmes.

Other projects that have been completed in 2015 include a Scottish Pacific oyster survey, an invasive non-native species early warning system project, a genetic study of UK populations of carpet sea squirt *Didenmum vexillum* and the 2015 marina surveys in Orkney.

New records for 2015 include the asp, *Aspius aspius*, from Churchgate Fishery, near Battlesbridge, Essex (England) and the Gulf wedge clam, *Rangia cuneata,* from the River Witham in Boston. Many American lobsters *Homarus americanus* and Dungeness crabs *Metacarcinus magister* were released off the south coast of England as part of a Buddhist religious ceremony in June. Roughly half of these have since been caught and efforts to capture the rest are on-going. New locations also include two American lobsters from the Solway Firth, compass seasquirt and Japanese wireweed in Orkney, Pacific oyster *Crassostrea gigas* in Shetland, carpet sea squirt in Loch Creran, a population of pumpkinseed in Basildon and dark false mussels, *Mytilopsis leucophaeata*, from the River Witham in Boston

Overview

Regulations

The Alien and Locally Absent Species in Aquaculture (Scotland) Regulations 2015 came into force in Scotland on 3 April 2015.

Intentional introductions

Fish

Summaries of imports of salmonid eggs into the UK can be found in Finfish News for England and Wales (www.cefas.co.uk/publications/finfish-news.aspx) and Marine Scotland Science publications for Scotland (www.scotland.gov.uk/Topics/marine/science/Publications/publicationslatest/FishFarmProductionSurveys). UK export statistics are also presented in these publications.

Invertebrates

Summaries of the imports of Pacific oysters can be found for England and Wales in Finfish News (http://www.cefas.co.uk/publications/finfish-news.aspx) and Marine Scotland Science publications for Scotland (www.scotland.gov.uk/Topics/marine/science/Publications/publicationslatest/FishFarmProductionSurveys). Deliberate releases of Pacific oysters for cultivation, mainly from UK hatcheries, continue at a similar level to that in previous years. Oyster consignments for growing on have been imported from Guernsey and France. Movement restrictions to prevent the spread of a new and highly pathogenic strain of oyster herpes virus (OsHV-1 μvar) remain in place.

Imports of non-native species of live bivalve molluscs and crustaceans for human consumption continue.

There are continued low-level attempts to introduce non-native crayfishes, which are illegal to keep in the UK under current national legislation, through the aquarium trade.

A large number of American lobsters and Dungeness crabs were released off the south coast of England as part of a Buddhist religious ceremony in June 2015. Officials were notified only days after the event, and Cefas along with the Marine Management Organisation (MMO) managed a rapid response process, where by local fishermen were tasked with laying pots in and around the release point in areas of suitable habitat with a view of capturing as many as possible to reduce the probability of a populations establishing. In addition to tracking ad-hoc captures of animals to determine spread, a rapid risk assessment was conducted for Dungeness crabs to determine their likely impact. The species was assessed as low impact, partly as only male animals are legally exported, and therefore available as imports in the UK for purchase. To date, approximately half the total number of animals released are believed to have been re-captured, either as part of the rapid response efforts or chance captures that have been reported. Not all chance captures were corroborated, and there may be other captures that have not be reported. Two berried female American lobsters have been landed from the area. Samples have been collected, but parentage has not been examined yet

Unintentional introductions

New sightings

The Gulf wedge clam *Rangia cuneata* was reported from two locations along the River Witham in Lincolnshire in August 2015. This is the first record for this clam in the UK, however it is estimated that the invasion could have occurred about six years ago. Discharged ballast water is the likely vector. Willing (2015) provides details.

Invertebrates

Fish

In January 2015, a specimen of asp *Aspius aspius*, said to be about 4.5 kg, was captured by two boys at the Churchgate Fishery, near Battlesbridge (County of Essex).

Previous sightings

Invertebrates

Two suspect American lobsters were reported by a fisherman from the Solway Firth in Ocotber 2015. A single photo was provided but no ID confirmation was made. Information was passed onto the Solway Firth Inshore Fishery. There have been no further sightings of lobsters in the area. The compass seasquirt *Asterocarpa humilis* and Japanese wireweed *Sargassum muticum* were observed in Orkney, two Pacific oysters were recorded from mussel lines in Shetland and the carpet sea squirt was identified by eDNA analysis from Loch Creran. The fourth UK record for the dark false mussel Mytilopsis leucophaeata was observed at two locations along the River Witham, together with the Gulf wedge clam.

Fish

In April 2015, a new population of pumpkinseed *Lepomis gibbosus* was found in Dunton Lake (near Basildon, County of Essex). This is the first confirmed extant population of the species north of the River Thames. The species was introduced as a contaminant of a consignment of native aquatic plants, which were transported to, and stocked in from, trays containing water – a clear disregard of guidance from the 'Be Plant Wise' initiative regarding aquatic plant transport.

Species not yet reported or observed

Priority marine NNS monitoring and surveillance lists have been developed by Cefas. This includes high priority species currently present and those that are considered likely to arrive in the near future.

Pathogens –

Sightings/records

Oyster herpes virus (OHV-1µVar) was found in the River Roach in Essex, the Kent coast at Minnis Bay and Pegwell Bay, and the River Teign in Devon after mortality events were reported to the Fish Health Inspectorate at Cefas.

The parasite *Haplosporidium costale* was identified in stocks of Pacific oyster on the River Dart in Devon. This followed identification of *H. nelsoni* in oysters from the same location in 2014, and was the first case of *H. costale* seen in Pacific oysters in the UK. Further work is ongoing to determine whether or not the presence of these parasites is significant in these oysters.

General information

Cefas has conducted work in collaboration with the University of Leeds (Alison Dunn) to help underpin the "Check, Clean, Dry" campaign. This has included examining the effectiveness of hot water as a bio-security measure on a range of species including zebra mussels *Dressena polymorpha*, signal crayfish *Pacifastacus leniusculus*, killer shrimp *Dikerogammarus villosus*, floating pennywort *Hydrocotyle ranunculoides*, and curly water weed *Lagarosiphon major*. This work is now published (see Anderson *et al.* 2015. Other work has included a fact-finding mission to New Zealand to gather information on the sustainable implementation of effective biosecuirty campaigns; a manuscript on this work has been submitted to the *Journal of Environmental Management*. Reports from this work are available, for copies of the reports or further information contact Paul Stebbing (paul.stebbing@cefas.co.uk).

Work initiated in 2012 is being conducted by Cefas examining methods of controlling invasive species of crayfish. There are several different strands to this work looking at different forms of control including: male sterilisation, biocidal control and physical removal. The male sterilisation work is on-going as is the biocidal work, the trapping work is due to finish March 2016. For further information contact Paul Stebbing (paul.stebbing@cefas.co.uk).

The aquatic invasive species screening kit (AS-ISK) was released on the Cefas website in October 2015 and is available for free download at: https://www.cefas.co.uk/services/research-advice-and-consultancy/invasive-and-non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/.

This new decision-support tool is applicable to all plants and animals from marine, brackish and fresh waters, regardless of climate zone. This electronic tool kit combines the generic risk screening module of ENSARS, the European Non-native Species in Aquaculture Risk Assessment Scheme (Copp *et al.* 2014), within the framework the Fish Invasiveness Screening Kit (Copp *et al.* 2009; Lawson *et al.* 2013). A manuscript in which AS-ISK is described, with an example screening of Manila clam, was submitted to an international peer-reviewed journal in December 2015. A second manuscript is currently being prepared in which AS-ISK assessments are presented for a range of freshwater, brackish and marine species, including multiple assessments of the Manila clam *Venerupis philippinarum* by several risk assessors for different risk assessment areas world-wide;

this study involves several WGITMO delegates and submission to a peer-reviewed journal is anticipated for sometime in second half of 2016. For further information contact Gordon H. Copp (gordon.copp@cefas.co.uk).

The Marine Pathways Project, which aimed to reduce the risk associated with pathways by which marine invasive non-native species may be introduced into the British Isles, finished in 2015. However, the project steering group which includes representatives from many organisations across UK and Ireland will continue to share knowledge and experience and provide advice on Marine NIS to inform policy and management in an advisory capacity. Further work on the marine invasive non-native species is planned to be co-ordinated through the group in the future. Published reports, papers and other output are currently available, along with additional information on the project can be found at the projects website, further outputs will be placed on the website as they become available:

(www.nonnativespecies.org/index.cfm?sectionid=105)
For further information contact Hannah Tidbury (Hannah.tidbury@cefas.co.uk) or Paul Stebbing (paul.stebbing@cefas.co.uk).

Research and development of molecular tools continues at Cefas for the detection of non-native species, in particular the use of environmental DNA (e-DNA) and substratum scrapes. The eDNA approach, which has been submitted to a peer-reviewed journal for publication (Davison *et al.* unpublished) has been applied to assess to efficacy of an attempt to eradicate topmouth gudgeon (*Pseudorasbora parva*) from an angling pond. Using a robust sampling protocol, eDNA analysis of water samples from the pond revealed that topmouth gudgeon was still present, and subsequent intensive trapping at the detection locations revealed a small number of specimens. Marine work has focused on the detection of target species relevant to the MSFD and WFD, and methods have been field validated. The marine-based DNA analysis of substratum scraps was finalised March 2015, and the work on inland still waters will be expanded in April 2016 to include the detection of non-native freshwater and diadromous fishes in running waters. For further information on the detection of marine species, contact Paul Stebbing (paul.stebbing@cefas.co.uk and for freshwater and diadromous fishes contact Gordon H. Copp (gordon.copp@cefas.co.uk).

A Marine Scotland Science (MSS) study of UK *Didemnum* populations is complete, 'Molecular identification of carpet sea squirt from sites around the UK coastline' and has been published in *BioInvasions Recods*. For further information contact Lyndsay Brown (lyndsay.brown@scotland.gsi.gov.uk)

Marine Scotland Fish Health Inspectors were contacted by a shellfish farmer concerned about suspectcarpet sea squirt at Loch Creran on the west coast of Scotland. MSS, SNH, SEPA and SAMS have been working together in response to this. The loch is a designated Special Area of Conservation (SAC) due to the presence of serpulid reefs, one of a few types of similar reef in Europe. Anecdotal reports mention white growth forms to be present on the reefs and on the seabed (mixture of rocks, cobbles and old mussel farm gear). It also apparent that an environmental company undertook eDNA analysis of water samples from various sites within the loch, seemingly confirming the presence of carpet sea squirt possibly during 2014 or 2015. SNH have since conducted a dive survey of the loch and collected samples, however they reported no obvious carpet sea squirt growth. Samples will undergo molecular sequencing at MSS for ID verification. Further dive surveys may also go ahead. For further information contact Lyndsay Brown (lyndsay.brown@scotland.gsi.gov.uk)

Orkney Islands Council is continuing with their annual marine non-native species monitoring programme. A total of ten non-native species were recorded during the 2015 monitoring programme, all of these have previously been recorded in Orkney. In 2015 a local Field Club member found Japanese wireweed *Sargassum muticum* on the west coast of Orkney Mainland. This is the first record of Japanese wireweed in Orkney Islands and it was reported through the iSpot website by the recorder themselves. For further information contact Jenni Kakkonen (jenni.kakkonen@orkney.gov.uk)

Biosecurity guidance report for preventing the introduction of non-native species during site developments or operational activities in marine based industries has now been adopted by the UK environment agencies, including Scottish Natural Heritage, Natural England and Natural Resources Wales (Payne *et al.* 2014). This work has been progressed as part of the Marine Pathways Projec.

Chris Nall (Supervised by M-L Schappy, A Guerin and E Cook, UHI-Thurso and SAMS) successfully defended his PhD in January 2015 entitled 'Marine non-native species in northern Scotland and the implications for the marine renewable energy industry'.

The Invasive Non-Native Species Early Warning System project report has been completed (see Cook *et al.* 2015). This work included comparing the effectiveness of early warning systems for the detection of marine invasive non-native species in Scottish waters. This work was progressed as part of the Marine Pathways Project. The methods looked at included rapid assessment survey, settlement panels, scrape samples, in-situ and settlement panel photographs. For further information contact Elizabeth Cook (elizabeth.cook@sams.ac.uk)

A Scottish Pacific oyster survey commissioned by the Scottish Aquaculture Research Forum has been completed (see Cook *et al.* 2014). Sixty sites were surveyed and results provided baseline data on the prevalence and scale of 'wild' Pacific oysters in Scotland. For further information contact Elizabeth Cook (elizabeth.cook@sams.ac.uk)

A pilot Pentland Firth and Orkney Waters Marine Spatial Plan has been developed by a working group consisting of Marine Scotland, Orkney Islands Council and Highland Council to pilot the process of regional marine planning in Scotland. The pilot Plan is non statutory and sets out an integrated planning policy framework to guide marine development, activities and management decisions, whilst ensuring the quality of the marine environment is protected. One of the general policies within the Plan will deal with invasive non-native species. The Plan is in the final stages of obtaining approval and, if approved, will be used by the three organisations as a material consideration in the determination of relevant marine licences, consents and planning applications. For further information contact Tracy McCollin (tracy.mccollin@gov.scot).

Meetings

Past year (2015)

The following meetings are either focused on non-native species or had non-native species sessions as part of their programme:

Canadian Conference for Fisheries Research (St John's, Newfoundland, Canada; 7–9 January 2015)(www.uwindsor.ca/glier/ccffr/).

Marine Alliance for Science and Technology Scotland (MASTS) Special Session 'Environmental Biohazards' at the Annual Science Conference, Glasgow (31 Sept – 3 Oct 2015). Invasive species related talks included:

- Bella Galil (Israel) Oceanographic and Limnological Research Institute) - 'Double trouble': the expansion of the Suez Canal and marine bioinvasions in the Mediterranean Sea.
- Jennifer Loxton (UHI) - Investigations into the life history of *Schizoporella japonica*; a unique and troublesome non-native fouling bryozoan.

PICES Pathway Risk Assessment Workshop related to tsunami debris and non-indigenous species (Annapolis, Maryland, USA; 16–18 November 2015).

12th GB Stakeholder Forum on Non-Native Species (Edinburgh, Scotland, 16 June 2015).

Symposium for European Freshwater Sciences (SEFS-9) 2015 – Freshwater sciences coming home (Geneva, Switzerland; 5–10 July 2015)

European Workshop on Alien Species and the EC Water Framework Directive (Peterborough, UK; 8–9 December 2015)

Meetings in 2016

The following meetings are either focused on non-native species or have non-native species sessions as part of their programme:

Canadian Conference for Fisheries Research (Montréal, Canada; 6–8 January 2016)(www.uwindsor.ca/glier/ccffr/).

27th USDA Interagency Research Forum on Invasive Species (Annapolis, Maryland, USA; 12–14 January 2016).

Mississippi River Basin Panel on Aquatic Nuisance Species Meeting (Gulfport, Mississippi, USA; 13–14 January 2016)

9th International Conference on Marine Bioinvasions (Sydney, Australia; 19–21 January 2016)

ICAIS 2016 – 19th International Conference on Aquatic Invasive Species (Winnipeg, Manitoba, Canada; 10–14 April 2016)

Freshwater Invasives (FINS-II) – Networking for Strategy (University of Zagreb, Croatia; 11–14 July 2016)

International Society of Limnology (SIL) – Alien species ecological impacts: from genomics to macroecology (Turin, Italy; 31 July – 5 August 2016)

Neobiota 2016 – 9th European Conference on Biological Invasions: "Biological Invasions: interactions with environmental change" (Vianden, Luxembourg; 14–16 September 2016).

References

Anderson, L.G., Dunn, A.M., Rosewarne, J.P. & Stebbing, P.D. (2015). Invaders in hot water: a simple decontamination method to prevent the accidental spread of aquatic invasive non-native species. *Biological Invasions* 17, 2287–2297.

Collin, S.B., MacIver, K. & Shucksmith, R. (2015). *A biosecurity plan for the Shetland Islands*. NAFC Marine Centre. 66 pp.

Collin, S.B., Tweedle, J.F. & Shucksmith, R.J. (2015). Rapid assessment of marine non-native species in the Shetland Islands, Scotland. *BioInvasions Records* 4, 147–155.

Cook, E.J., Beveridge, C.M., Lamont, P., O'Higgins, T. & Wilding, T. (2014). Survey of Wild Pacific Oyster Crassostrea gigas in Scotland. Scottish Aquaculture Research Forum Report SARF099, 46 pp.

Cook, E.J., Beveridge, C., Twigg, G. & Macleod, A. (2015). *Assessing the Effectiveness of Early Warning Systems for the Detection of Marine Invasive Non-Native Species in Scottish Waters*. SAMS, Scottish Natural Heritage & Marine Scotland Science Commissioned Report No. 874, 32 pp. http://www.snh.org.uk/pdfs/publications/commissioned_reports/874.pdf

Copp, G.H., Vilizzi, L., Tidbury, H., Stebbing, P.D., Tarkan, A.S., Moissec, L. & Goulletquer, P.H. (unpublished) The Aquatic Species Invasiveness Screening Kit (AS-ISK) – a generic risk identification tool for marine, brackish and freshwater taxa. (submitted manuscript).

Davison, P.I., Créach, V., Liang, W-J., Andreou, D., Britton, J.R. & Copp, G.H. (unpublished) Laboratory and field validation of a simple method for detecting four species of non-native freshwater fish using eDNA. (revised and re-submitted manuscript).

Graham, J., Collins, C., Lacaze, J-P., Brown, L. & McCollin, T. (2015). Molecular identification of *Didemnum vexillum* Kott, 1982 from sites around the UK coastline. *BioInvasions Records* 4, 171–177.

Macleod, A., Cook, E.J, Hughes, D. & Allen, C. (2015). *Investigating the Impacts of Marine Invasive Non-Native Species*. A report by SRSL for Natural England & Natural Resources Wales, pp. 59.

Macleod, A. & Jaugeon, B. (2015). *A Biosecurity Plan for Lochnell Oysters: Incorporating non-native species and diseases*. A report by SRSL for Lochnell Oysters, pp. 43.

Nall, C.R., Geurin, A.J. & Cook, E.J. (2015). Rapid assessment of marine non-native species in northern Scotland and a synthesis of existing Scottish records. *Aquatic Invasions* 10, 107–121.

Payne, R.D., Cook, E.J. & Macleod, A. (2014) Marine Biosecurity Planning – Guidance for producing site and operation-based plans for preventing the introduction of non-native species. Report by SRSL Ltd. in conjunction with Robin Payne to the Firth of Clyde Forum and Scottish Natural Heritage, 39 pp. (http://www.snh.gov.uk/docs/A1294630.pdf)

Whomersley, P., Murray,J.M., McIlwaine, P., Stephens, D. & Stebbing, P.D. (2015). More bang for your monitoring bucks: Detection and reporting of non-indigenous species. *Marine Pollution Bulletin* 94, 14–18.

Willing, M. (2015). Two invasive bivalves, *Rangia cuneata* (G.B. Sowerby I, 1831) and *Mytilopsis leucophaeata* (Conrad, 1831), living in freshwater in Lincolnshire, eastern England. *Journal of Conchology* 42, 189–192.

United States

Prepared by Judith Pederson, with contribution from Paul Fofonoff, Smithsonian Environmental Research Center

Highlights

There is only one new non-native species reported this year, a polychaete, *Branchiomma coheni* that has been found in Tampa Bay Florida for several years.

The clinging jellyfish, *Gonionemus vertens* has been present since 1894, but is now causing severe stings associated with the Pacific species and may be a new introduction.

Genetic studies of two amphipod species, *Orchestia gammarellus* and *Corophium volutator* have been shown to be non-native in the Northwest Atlantic. Several recently introduced species (*Colpomenia peregrina* (moving south), *Palaemon macrodactylus*, *P. elegans*, and *Dasysiphonia japonica*) are expanding ranges; one the barnacle *Chthamalus fragilis* appears to be moving northward probably with increased temperatures.

1. Regulations

Aquaculture Regulations in the North Atlantic

Aquaculture requires a permit (issued by the U.S. Army Corps of Engineers in consultation with NOAA and other federal agencies. The Nationwide Permit 48, which is valid from March 19, 2012 – March 28, 2017 except where suspended or revoked. The North Atlantic states that adopted the Nationwide permit (most with regional exceptions) are Delaware, Florida, Georgia, Maryland, New Jersey, New York, North Carolina, South Carolina, and Virginia. States that have their a General Permit written for each state are Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island. The Nationwide Permit 48 is at http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/NationwidePermits.aspx and the General Permit is available at each state.

Ballast Water Regulatory Changes

Ballast water management reporting and recordkeeping was amended and finalized and effective February 22, 2016. The U.S. "Coast Guard will require vessels with ballast tanks operating exclusively on voyages between ports or places within a single Captain of the Port Zone to submit an annual report of their ballast water management practices. This rule also simplifies and streamlines the ballast water report form. Finally, this rule will allow most vessels to submit ballast water reports after arrival at a port or place of destination, instead of requiring submission of such reports prior to arrival. This rule will reduce the administrative burden on the regulated population, while still providing the Coast Guard with the information necessary to analyze and understand ballast water management practices." (https://www.federalregister.gov/articles/2015/11/24/2015–29848/ballast-water-management-reporting-and-recordkeeping).

2. Intentional

Synthesis of introductions

The United States imports (and exports) large amounts of marine organisms. These data are difficult to summarize and even more difficult to capture for the Northeast region of the US. For recent information about specifics visit

http://www.st.nmfs.noaa.gov/commercial-fisheries/foreign-trade/.

The most recent annual data has been summarized for 2014. Below is a summary of the imports taken directly from the web page. For information on exports and re-exported goods visit: http://www.st.nmfs.noaa.gov/Assets/commercial/trade/Trade2014.pdf

"U.S. imports of edible fishery products in 2014 were valued at $20.2 billion, up 12 percent from 2013. The quantity of edible imports was 2 523 120 metric tons, an increase of 22 214 tons (less than 1 percent) from the quantity imported in 2013. The volume of shrimp imported in 2014 was 567 551 tons, an increase of 62 973 tons, or 12.5 percent, from the quantity imported in 2013. Shrimp Imports were valued at $6.7 billion an increase of $1.4 billion (26.9 percent) from 2012). Shrimp imports accounted for 33 percent of the value of total edible imports. Imports of fresh and frozen salmon were 301 280 tons valued at $2.7 billion in 2014.

Imports of fresh and frozen tuna were 166 272 tons, down 40 852 tons (19.7 percent) from 2013. The value of fresh and frozen tuna imports decreased by 11 percent to $951 million. Imports of canned tuna were 155 193 tons, down 2383 tons (12.4 percent) from 2013. The value of canned tuna imports also decreased dropping $94.4 million (12.4 percent) from 2013. Imports of all fresh and frozen fillets and steaks amounted to 715 020 tons, an increase of 17 238 tons (less than 1 percent) from 2013. Total edible imports consisted of: 2 130 377 tons of fresh and frozen products valued at $17.8 billion; 312 138 tons of canned products valued at $1.9 billion; 41 103 tons of cured products valued at $293.5 million; 2776 tons of caviar and roe products valued at $35.3 million; and 36 726 tons of other products valued at $218.0 million.

Imports of nonedible fishery products were valued at $15.6 billion, $483.7 million (3.2 percent) more than in 2013. Total value of edible and nonedible fishery imports was $35.9 billion in 2014, $2.6 billion (7.9 percent) more than in 2013."

3. Unintentional

New Sightings

Gonionemus vertens A. Agassiz 1862 (Clinging Jellyfish, Cnidaria, Hydrozoa, Northwestern Pacific strong-stinging form, Waquoit Bay and Martha's Vineyard Ponds, Massachusetts (1990–2011, 41°33' N, 70° 31' W; Govindarajan and Carman 2015).

This hydrozoan was described from the Northeast Pacific, and has a small, inconspicuous polyp, and a conspicuous medusa, which often clings to vegetation, but also swims to the surface at night. *Gonionemus vertens* was first collected in Atlantic waters in Eel Pond, Woods Hole, Massachusetts in 1894, and became abundant in local waters but apparently disappeared after a massive, widespread, Eelgrass (*Zostera marina*) die-off in 1931 (Edwards 1976). Sporadic observations of *G. vertens* were made in southern New England in the 1960s, but beginning in the 1990s, 'blooms' of the medusae were noticed in lagoons on the south shore of Cape Cod, and on Martha's Vineyard. Researchers and shellfishers working in the ponds suffered severe stings and health symptoms, including muscle cramps, chest tightness, and swollen throats, and received hospital treatment (Govindarajan and Carman 2015). Severe stings are known for Northwestern Pacific populations of *G. vertens*, but not for Northeast Pacific populations, or previously introduced *G. vertens* populations in New England and Europe. This suggests that a cryptic introduction of the Northwestern Pacific *G. vertens* form has occurred is Govindarajan and Carman 2015). Introduced populations of *G. vertens* are known from southern California, many locations in Europe, and recently in Argentina (Edwards 1976; Rodriguez *et al.* 2014), but severe stinging has not been reported. Genetic, morphological, and life history studies of this hydrozoan are highly desirable.

Branchiomma coheni (Tovar-Hernández & Knight-Jones 2006). Annelida, Polychaeta. Amarina, Tampa Harbor, Florida (2012–2014, 27°53'7.58"N, 82°32'2.29"W). *Branchiomma coheni is a* sabellid tubeworm which was described from the Pacific coast of Panama, near the mouth of the Panama Canal. This worm occurs in rocky tide pools, marinas and docks, cultured oysters, and locks at the Pacific end of Panama Canal, ranges north to the Gulf of California. In 2012 and 2014, it was found on fouling plates at one marina in Tampa, Florida. This worm was probably transported through the Panama Canal in ballast water of fouling. Several species of sabellid and serpulid worms have been transported through the canal, between the two oceans, in both directions (Keppel *et al.* 2015).

Previous sightings

Genetic studies have uncovered several probable early transatlantic invaders, with wide eastern Atlantic ranges, but restricted ranges and low genetic diversity in the northwestern Atlantic. Previous studies have supported introduced status for *Littorina littorea* and its trematode parasite *Cryptocotyle lingua (*Blakeslee *et al.* 2008), and for the polychaete *Hediste diversicolor* [*"Nereis diversicolor"*] (Einfeldt *et al.* 2014). A biogeographic study of peracarid crustaceans suggested introduced status for Northwest Atlantic populations of several amphi-Atlantic amphipods (Chapman 2000). Recent genetic studies support introduced status for *Corophium volutator* (Einfeldt and Addison 2015) and *Orchestia gammarellus* (Henzler and Ingólfsson 2008).

Corophium volutator (Pallas, 1766)

Crustacea-Amphipoda The tube-building amphipod *Corophium volutator* has a wide range in the Eastern Atlantic, from Norway to the Mediterranean, but in the Western Atlantic is confined to the Gulf of Maine (Bousfield 1973). It is missing from historical 19th-century US fisheries collections from the Gulf of Maine (US National Museum of Natural History 2016; Yale Peabody Museum of Natural History 2016), but was collected in the Bay of Fundy by the Biological Board of Canada, and in a duck stomach in Maine, before 1934 (Shoemaker 1934). An unpublished early molecular study suggested strong genetic divergence between European and North American populations (A. B. Wilson, unpublished data, cited by Wilson *et al.* 1997). A more recent extensive study found reduced genetic diversity, and a population comprised of a subset European genotypes, probably with multiple introductions. A likely vector is the semi-dry ballast of sailing ships (Einfeldt, and Addison 2015). This amphipod has large populations on intertidal mudflats in the Gulf of Maine and Bay of Fundy, and ranges south to Boston, Massachusetts (Bousfield 1973; Bell *et al.* 2005). *Corophium volutator* is a major ecological engineer on mudflats of the Gulf of Maine and Bay of Fundy, and a major food item for fishes and shorebirds. (Wilson *et al.* 1997). The introduction of this amphipod may have had large impacts on intertidal habitats and foodwebs.

Crustacea-Amphipoda The littoral amphipod *Orchestia gammarellus* (Pallas 1766) also has a similar wide Eastern Atlantic range, from Norway and the Faroe Islands to the Mediterranean and Black Seas, but has a limited East Coast range, from Casco Bay, Maine, to eastern and southern Newfoundland (Bousfield 1973; Lincoln 1979). This upper-intertidal sand-hopper was collected in Eastport Maine, in 1864 (Yale Peabody Museum of Natural History 2016), and was first found in Iceland in 1968 (Henzler and Ingólfsson 2008). Iceland and Nova Scotia populations were patchy in their distribution, and have a subset of the genetic diversity of the European population (Henzler and Ingólfsson 2008). This amphipod occurs in the wrackline of sandy and rocky shore (Bousfield 1973), so transport in the dry ballast, or damp cargo of wooden ships is likely.

General information

Range Expansions

In 2009 *Tricellaria inopinata* was first reported in Eel Pond, Woods Hole, Massachusetts and subsequently found in Boston Harbor, Marblehead and Gloucester, Massachusetts. Johnson and Woolacott (2015) developed a suite of polymorphic microsatellite loci and used these to examine *T. inopinata* in various locations. The data suggest that Eel Pond was the origin of species that arrived in Boston Harbor, but that Marblehead and Gloucester populations were the result of multiple introductions to the North American coast. In Woods Hole, there has been a decrease in the native species attributed in part to the success of *T. inopinata* appears to be related to their ability to reproduce earlier than native bryozoans. There was no additional report of range expansions from last year, which was from Newport Rhode Island to Hampton, New Hampshire.

Chthamalus fragilis has been from Tampa Bay to Cape Cod Bay, Massachusetts, a boundary area and believed to be expanding northward. Although the barnacle, *Chthamalus fragilis* was found in Woods Hole, Massachusetts in 1898, it has since been reported south (Buzzards Bay, and Vineyard Sound and from Sandwich at the end of the Cape Cod Canal to Provincetown, Massachusetts (Outer Cape). The origin of the northern populations is controversial. To examine this issue researchers examined mitochondrial cytochrome c oxidase I sequence diversity to better understand the genetic structure between southern and northern population (Govindarajan *et al.* 2015; Keppel *et al.* 2015). They found three distance monophyletic haplogroups, one restricted to New England

and Virginia populations. Their findings support northern expansion of *C. fragilis* in its northern range.

During the summer of 2014, a Rapid assessment Survey was conducted by James Carlton and colleagues throughout the northwestern Atlantic from Maine to New Jersey (Carlton and Weigle 2015). During the survey, *Palaemon macrodactylus* was collected from Newington, New Hampshire and south to Barnegat Bay, New Jersey, extending the northern portion of its range from Boston, Massachusetts. It has also been found in the Chesapeake Bay area. *Palaemon elegans*, formerly reported from Kennebunk Maine to Borne Massachusetts, was found in 2014 at Hampton, New Hampshire and as far south as Scarborough Beach, Rhode Island, thus extending its southern range.

The red alga, *Dasysiphonia japonica* ["*Heterosiphonia japonica*"] has expanded its distribution (Low *et al.* 2015) and is found as far north as mid-coastal Maine at the following locations (44.0308N, -68.8852W; 43.1187N, -70.6359W), extending its range north from Cape Elizabeth, Maine (C. Casals, Gulf of Maine Research Institute, pers. comm., 2016). Its previous southern distribution is identified as Waterford, Connecticut (Newton 2013) and it has also been found at one location in Mahone Bay, Nova Scotia (Savoie and Saunders 2013).

The brown alga, *Colpomenia peregrina* was initially found in Atkins, Nova Scotia Canada in 1960 and now extends from Grand Barachois Lagoon, Newfoundland to South Wellfleet, MA (Mathieson *et al.* in press).

Species Lists

In a soon to be published of the complete and current taxonomic lists and more of algae found in the Northwest Atlantic (from Canadian Arctic to Maryland. In the book they identify 25 algal species found from Downeast Maine (Bay of Fundy) to Maryland. Several of these species have not been previously reported although they have been present for many years. Once the book is published, a list will be prepared along with references for the annual report. For those who may want a copy of the book, the contact information is given below.

Mathieson, AC and Dawes CJ (in press) Seaweeds of the Northwest Atlantic; Botany / Environmental Studies, 000 pp., 00 illus., $00.00 paper, ISBN 978–1-62534–000–0, $90.00 hardcover, ISBN 978–1-62534–000–0, pubdate 201x.

This book is expected to be published soon and can be found at www.umass.edu/umpress; based on the fall / winter 2015–2016 release of the University of Massachusetts Press.

Species distributions

Gonionemus vertens (1990–2011, 41°33' N, 70° 31' W)

Branchiomma coheni (2012–2014, 27°53'7.58"N, 82°32'2.29"W).

Not Seen Species Yet

Two native species of *Palaemon* shrimp are expected to expand their ranges (Carlton and Weigle 2015). *Palaemon floridanus* was found in Boston Harbor in 2013 but not in 2014, nonetheless it is expected to expand northward. In addition the native shrimp, *P. mundusnovus* , which is found south of Cape Cod, is expected to expand northward.

The shrimp *Palaemon adspersus* (Baltic Shrimp, Baltic Prawn), native to the Northeast Atlantic (Norway to the Black sea) was collected in the Gulf of St. Lawrence in Newfoundland and the Magdalen Islands, Quebec, in 2011–2012 (González-Ortegón *et al.* 2015). This shrimp should be looked for in US waters, where it would join the introduced species *P. elegans* and *P. macrodactylus*, as well as the native shrimps formerly in the genus *Palaemonetes P. pugio*, *P. vulgaris*, and *P. mundusnovus* (= *Palaemonetes intermedius*). González-Ortegón *et al.* 2015) thoughtfully give a key to the native and introduced *Palaemon* found from New Jersey to Canada.

The Royal Damselfish, *Neopomacentrus cyanomos,* native to the Indo-Pacific, from the Red Sea to Japan and Australia was found in 2013 in the southern Gulf of Mexico, off coral reefs south of Veracruz, Mexico. A population was found to be established, with 15 specimens collected, and many visual sightings of schools (Gonzalez and de la Cruz-Francisco 2014). Ballast water was suggested as a likely vector of introduction, but Web searches indicate that this species is common and inexpensive in the aquarium trade. A modelling study suggests that currents are not favorable for dispersal of this species to Florida and the northern Gulf of Mexico. However, anomalous water flows due to hurricanes are possible, as is ballast water transport (Johnson and Akins 2016). A sudden appearance of this fish in Guam was attributed to ballast water transport from the Philippines (Eldredge 1994).

General Information

Gonionemus vertens (1990–2011, 41°33' N, 70° 31' W)

Branchiomma coheni (2012–2014, 27°53'7.58"N, 82°32'2.29"W).

4. Pathogens

Haplosporea- The unidentified *Bonamia* sp., found infecting introduced triploid Suminoe Oysters (*Crassostrea ariakensis*) and Mangrove Oysters (*Ostrea equestris*) in 2003–2007 in North Carolina, Florida, and Virginia has been identified as *B. exitiosa* (Hill-Spanik *et al.* 2015), originally described from New Zealand Flat Oysters (*O. chilensis*). Recent genetic work was suggested that *O. equestris* and *O. chilensis* are synonyms of *O. stentina*, described from the Mediterranean (Shilts *et al.* 2007). *Bonamia exitiosa* appears to be widely distributed, with regional and cosmopolitan lineages. Comparisons of populations of *B. exitiosa* have indicated 4 major genetic groups: 'Cosmopolitan,' 'Southern Hemisphere', 'western Atlantic', and 'California', with some shared genes. Hill-Spanik *et al.* (2015) suggest that the dispersal of this parasite could have occurred either by natural means, or with early ship voyages, as early as the 16th century. The widespread distribution of *O. stentina* (Shilts *et al.* 2007), assuming the synonymy is correct, suggests that this species was the vector for the spread of the parasite, whether by natural or anthropogenic means.

Paul Fofonoff, Smithsonian Environmental Research Center, treats *Bonamia exitiosa* as cryptogenic in the NEMESIS (National Exotic Marine and Estuarine Species Information System).

5. Meetings

1/18–21/2016 The International Conference on Marine Bioinvasions, Sydney, Australia

The next International Conference on Marine Bioinvasions will take place in Argentina in 2018.

Mary Carman organizer of the International Invasive Sea Squirt Conference announced the release of the final version of the special IISSC-V issue of MBI - please see at http://www.reabic.net/journals/mbi/2016/Issue1.aspx.

6. References and bibliography

Bell, R., R. Buchsbaum, C. Roman, and M. Chandler. 2005. Inventory of Intertidal Marine Habitats, Boston Harbor Islands National Park Area. *Northeastern Naturalist,* Volume 12, Special Issue 3: 169–200

Blakeslee, A. M. H., J. E. Byers, and M. P. Lesser. 2008. Solving cryptogenic histories using host and parasite molecular genetics: the resolution of *Littorina littorea*'s North American origin. Molecular Ecology 17: 3684–3696.

Bousfield, E. L. 1973. Shallow-water gammaridean Amphipoda of New England. Comstock Publishing Associates, Ithaca NY.

Carlton, J. T. and S. Weigle. 2015. Shrimp Expedition 2014 (Shrimp EX14) A rapid Assessment Survey of Non-Indigenous Marine and Estuarine Shrimp Species in the Northeastern United States. Williams College-Mystic Seaport Maritime Studies Program, Mystic Connecticut 06355.

Chapman, J. W. 2000. Climate effects on the geography of nonindigenous peracaridan crustacean introductions in estuaries. Pages 66–80 *in* J. Pederson, editor. Marine Biological Invasions; Proceedings of the first national conference, January 24–27, 1999. MIT Sea Grant College Program, Cambridge, MA.

Crickenberger, S. 2016. Predicting a range shift and range limits in an introduced tropical marine invertebrate using species distribution models. Hydrobiologia 763: 193–205

Edwards, C. 1976. A study in erratic distribution: the occurrence of the medusa *Gonionemus* in relation to the distribution of oysters. Advances in Marine Biology 14: 251–284.

Einfeldt, A. L., J. R. Doucet, and J. A. Addison. 2014. Phylogeography and cryptic introduction of the ragworm *Hediste diversicolor* (Annelida, Nereididae) in the Northwest Atlantic. Invertebrate Biology 133: 232–241.

Einfeldt, A. L. and J. A. Addison. 2015. Anthropocene invasion of an ecosystem engineer: resolving the history of *Corophium volutator* (Amphipoda: Corophiidae) in the North Atlantic. Biological Journal of the Linnean Society 115: 288–304

Eldredge, L. G. 1994. Introductions of commercially significant aquatic organisms to the Pacific islands. South Pacific Commission, Noumea, New Caledonia.

González-Gándara, C. and V. de la Cruz-Francisco. 2014. Unusual record of the Indo-Pacific pomacentrid *Neopomacentrus cyanomos* (Bleeker, 1856) on coral reefs of the Gulf of Mexico. BioInvasions Records 3:in press.

González-Ortegón C., P. Sargent, G. Pohle, and A. Martinez-Lage. 2015. The Baltic prawn *Palaemon adspersus* Rathke, 1837 (Decapoda, Caridea, Palaemonidae): first record, possible establishment, and illustrated key of the subfamily Palaemoninae in northwest Atlantic waters. Aquatic Invasions 10: 275–285.

Govindarajan, A. F. and M. R. Carman. 2015. Possible cryptic invasion of the Western Pacific toxic population of the hydromedusa *Gonionemus vertens* (Cnidaria: Hydrozoa) in the Northwestern Atlantic Ocean. Biological Invasions 18(2): 463–469

Govindarajan, A. F., F. Buksa, K. Bockrath, J. P. Wares, and J. Pineda 2015. Phylogeographic structure and northward range expansion in the barnacle *Chthamalus fragilis*. PeerJ 3: e926

Henzler, C. M. and A. Ingólfsson. 2008. The biogeography of the beachflea, *Orchestia gammarellus* (Crustacea, Amphipoda, Talitridae), in the North Atlantic with special reference to Iceland: a morphometric and genetic study. Zoologica Scripta 37(3): 57–70

Hill-Spanik, K. M., J. R. McDowell, N. A. Stokes, K. S. Reece, E. M. Burreson, and R. B. Carnegie. 2015. Phylogeographic perspective on the distribution and dispersal of a marine pathogen, the oyster parasite *Bonamia exitiosa*. Marine Ecology Progress Series 536: 65–76.

Johnson, C. H. and R. M. Woollacott. 2015. Analyses with newly developed microsatellite markers elucidate the spread dynamics of *Tricellaria inopinata* d'Hondt and Occhipinti-Ambrogi, 1985 – a recently established bryozoan along the New England seashore. Aquatic Invasions 10 (2): 135–145

Johnston, M. W. and J. L. Akins. 2016. The non-native royal damsel (*Neopomacentrus cyanomos*) in the southern Gulf of Mexico: An invasion risk? Marine Biology 163:Published online. DOI 10.1007/s00227–015–2777–7

Keppel, E., H. Tovar, and G. Ruiz. 2015. First record and establishment of *Branchiomma coheni (*Polychaeta: Sabellidae) in the Atlantic Ocean and review of non–indigenous species of the genus. Zootaxa 4058(4): 499–518

Lincoln, R. J. 1979. British Marine Amphipoda: Gammaridea. British Museum (Natural History), London.

Low, N. H. N., A. Drouin, C. J. Marks, and M. S. Bracken. 2015. Invader traits and community context contribute to the recent invasion success of the macroalga *Heterosiphonia japonica* on New England rocky reefs. Biological Invasions 17: 257–271; DOI 10.1007/s10530–014–0724-z

Mathieson, A. C., C. J. Dawes, L. A. Green, and H. Traggis. In press. Distribution and Ecology of *Colpomenia peregrina* (Phaeophyceae) Within the Northwest Atlantic.

Mathieson, A. C. and C. J. Dawes. In press. *Seaweeds of the Northwest Atlantic*. In press, University of Massachusetts Press.

Newton, C., M. E. S. Bracken, M. McConville, K. Rodrigue, and C. S. Thornber.

2013. Invasion of the red seaweed *Heterosiphonia japonica* spans biogeographic provinces in the western North Atlantic Ocean. PLoS ONE 8: e62261

Rodriguez, C. S., M. G. Pujol, H. W. Mianzan, and G. N. Genzano. 2014. First record of the invasive stinging medusa *Gonionemus vertens* in the southern hemisphere (Mar del Plata, Argentina). Latin American Journal of Aquatic Research 42: 653–657.

Savoie, A. M, and G. S. Saunders. 2013. First record of the invasive red alga *Heterosiphonia japonica* (Ceramiales, Rhodophyta) in Canada. BioInvasions Rec 2: 21–32.

Schofield, P. J., D. H. Huge, T. C. Rezek, D. H. Slone, and J. A. Morris, Jr. 2015. Survival and growth of invasive Indo-Pacific lionfish at low salinities. Aquatic Invasions 10:333–337.

Shilts, M. H., M. S. Pascual, and D. Ó Foighil. 2007. Systematic, taxonomic and biogeographic relationships of Argentine flat oysters. Molecular Phylogenetics and Evolution 44: 467–473.

Shoemaker, C. R. 1934. The amphipod genus *Corophium* on the east coast of America. Proceedings of the Biological Society of Washington 47: 23–32.

US National Museum of Natural History, 2002–2016. Department of Systematic Biology: Invertebrate Zoology collections database, Washington DC. http://collections.nmnh.si.edu/search/iz/

Wilson, A. B., B. J. S., and S. M. 1997. Genetic isolation of populations of the gammaridean amphipod, *Corophium volutator*, in the Bay of Fundy, Canada. Molecular Ecology 6: 917–923.

History, Yale Peabody Museum of Natural History 2008–2l06. YPM Invertebrate Zoology Online Catalog. http://collections.peabody.yale.edu/search/Search/Advanced?collection=Invertebrate Zoology.

Annex 4: Information on new invasions and range expansions of non-indigenous species as reported by Denmark

	Date of Record	Genus	Species	taxon (algae, etc.	Location name	Population status
Denmark	12 June 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Kerteminde Bugt	established
Denmark	01 July 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Sejrø Bugt	
Denmark	06 August 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Odense Havn	
Denmark	23 August 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Sejrø Bugt	
Denmark	31 August 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Sangstrup Klint, Djursland	
Denmark	07 September 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Kerteminde Fjord & Bugt	
Denmark	11 September 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Hornbæk (S Kattegat)	
Denmark	13 September 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Rungsted Havn (Øresund)	
Denmark	July - September 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Kerteminde, Nyborg & Svendborg Sund (Great Belt)	
Denmark	30 September 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Ellebæk Vig (Little Belt)	
Denmark	03 October 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Middelfart (Little Belt)	
Denmark	25 October 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Mariager Fjord	
Denmark	30 October 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Aalborg Havn (Limfjord)	
Denmark	31 October 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Nykøbing Mors (Limfjord)	
Denmark	31 October 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Bagenkop, Langeland (Great Belt)	
Denmark	07 November 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Asnæs & Røsnæs (Great Belt)	
Denmark	09 November 2015	*Mnemiopsis*	*leidyi*	Ctenophore	Isefjord	
Denmark	July 2015	*Hemigrapsus*	*sanguineus*	Crustacea, Decapoda	Wadden Sea	
Denmark	August 2015	*Hemigrapsus*	*takanoi*	Crustacea, Decapoda	Listerdyb, Wadden Sea	
Denmark	August 2015	*Crassostrea*	*gigas*	Mollusca, Bivalvia	Isefjord	
Denmark	Spring 2015	*Eriocheir*	*sinensis*	Crustacea, Decapoda	Limfjord, W of Aalborg	
Denmark	November 2015	*Eriocheir*	*sinensis*	Crustacea, Decapoda	Karrebæk Fjord (Great Belt)	

Denmark	November 2014	*Bonamia*	*ostreae*	Haplosporidia (Protozoan)	Venø Sund and Salling Sund (Limfjord)

Annex 5: Information on secies and population status for non-indigenous (NIS) and cryptogenic (CS) species for ICES ecoregions

Celtic Seas

Source: AquaNIS (as per 6. May 2016)

No.	Species name	Species status	Population status
1.	*Aerococcus viridans*	NIS	Not established
2.	*Alexandrium tamarense*	CS	Established
3.	*Amphibalanus improvisus*	CS	Established
4.	*Anguillicoloides crassus*	NIS	Established
5.	*Antithamnion densum*	CS	Unknown
6.	*Antithamnionella spirographidis*	NIS	Established
7.	*Antithamnionella ternifolia*	CS	Unknown
8.	*Aplidium glabrum*	CS	Established
9.	*Asparagopsis armata*	NIS	Established
10.	*Austrominius modestus*	NIS	Established
11.	*Balanus amphitrite*	NIS	Not established
12.	*Bankia fimbriatula*	NIS	Not established
13.	*Bonamia ostreae*	NIS	Established
14.	*Bonnemaisonia hamifera*	NIS	Established
15.	*Botrylloides violaceus*	NIS	Established
16.	*Brachidontes exustus*	NIS	Not established
17.	*Bugula fulva*	CS	Established
18.	*Bugula neritina*	NIS	Established
19.	*Bugula simplex*	NIS	Established
20.	*Caligus pageti*	CS	Unknown
21.	*Calyptraea chinensis*	NIS	Established
22.	*Caprella mutica*	NIS	Established

23.	*Chama sp.*	NIS	Not established
24.	*Chelicorophium curvispinum*	NIS	Established
25.	*Clymenella torquata*	NIS	Established
26.	*Codium fragile fragile*	NIS	Established
27.	*Colpomenia peregrina*	NIS	Established
28.	*Corbicula fluminea*	NIS	Established
29.	*Cordylophora caspia*	CS	Established
30.	*Corella eumyota*	NIS	Established
31.	*Coscinodiscus wailesii*	CS	Established
32.	*Crassostrea gigas*	NIS	Established
33.	*Crassostrea virginica*	NIS	Not established
34.	*Crepidula fornicata*	NIS	Established
35.	*Critomolgus actiniae*	CS	Established
36.	*Cryptonemia hibernica*	NIS	Established
37.	*Dendostrea frons*	NIS	Not established
38.	*Diadumene lineata*	NIS	Established
39.	*Didemnum vexillum*	NIS	Established
40.	*Dreissena polymorpha*	NIS	Established
41.	*Eriocheir sinensis*	NIS	Not established
42.	*Ficopomatus enigmaticus*	NIS	Established
43.	*Gammarus tigrinus*	NIS	Established
44.	*Gracilaria multipartita*	CS	Established
45.	*Gracilaria vermiculophylla*	NIS	Established
46.	*Haliotis discus*	NIS	Unknown
47.	*Haliotis tuberculata*	NIS	Not established
48.	*Haplosporidium nelsoni*	NIS	Established
49.	*Hemimysis anomala*	NIS	Established

50.	*Herrmannella duggani*	CS	Unknown
51.	*Heterolaophonte hamondi*	CS	Not established
52.	*Heterosigma akashiwo*	CS	Established
53.	*Heterosiphonia japonica*	NIS	Established
54.	*Homarus americanus*	NIS	Not established
55.	*Iridaea sp*	NIS	Unknown
56.	*Isochrysis spp.*	NIS	Unknown
57.	*Isognomon radiatus*	NIS	Not established
58.	*Jassa marmorata*	CS	Established
59.	*Karenia mikimotoi*	NIS	Established
60.	*Labyrinthula zosterae*	NIS	Unknown
61.	*Limnoria quadripunctata*	CS	Unknown
62.	*Marsupenaeus japonicus*	NIS	Not established
63.	*Martesia striata*	NIS	Not established
64.	*Megabalanus tintinnabulum*	NIS	Not established
65.	*Mercenaria mercenaria*	NIS	Not established
66.	*Mizuhopecten yessoensis*	NIS	Not established
67.	*Molgula manhattensis*	NIS	Unknown
68.	*Monocorophium insidiosum*	CS	Unknown
69.	*Monocorophium sextonae*	CS	Established
70.	*Muceddina multispinosa*	CS	Unknown
71.	*Mya arenaria*	CS	Established
72.	*Myicola ostreae*	NIS	Unknown
73.	*Mytilicola intestinalis*	CS	Established
74.	*Mytilicola orientalis*	NIS	Unknown
75.	*Neosiphonia harveyi*	NIS	Established
76.	*Odontella sinensis*	CS	Unknown

77.	*Oncorhynchus gorbuscha*	NIS	Unknown
78.	*Oncorhynchus mykiss*	NIS	Established
79.	*Ostracoblabe implexa*	NIS	Not established
80.	*Ostrea equestris*	NIS	Not established
81.	*Paralaeospira malardi*	NIS	Unknown
82.	*Perophora japonica*	NIS	Unknown
83.	*Phallusia mammillata*	CS	Established
84.	*Pileolaria militaris*	CS	Unknown
85.	*Pilumnoides inglei*	NIS	Not established
86.	*Pollicipes pollicipes*	CS	Not established
87.	*Polysiphonia subtilissima*	NIS	Unknown
88.	*Porcellidium ovatum*	CS	Established
89.	*Potamopyrgus antipodarum*	NIS	Established
90.	*Ruditapes philippinarum*	NIS	Not established
91.	*Sargassum muticum*	NIS	Established
92.	*Spartina townsendii var. anglica*	NIS	Established
93.	*Spartina x townsendii*	NIS	Unknown
94.	*Styela clava*	NIS	Established
95.	*Taeniastrotus sp.*	CS	Not established
96.	*Telmatogeton japonicus*	NIS	Not established
97.	*Terebella lapidaria*	NIS	Not established
98.	*Teredo navalis*	CS	Unknown
99.	*Tricellaria inopinata*	NIS	Established
100.	*Ulva californica*	NIS	Unknown
101.	*Undaria pinnatifida*	NIS	Established
102.	*Watersipora subtorquata*	NIS	Not established

Greater North Sea

Source: AquaNIS (as per 6. May 2016)

No.	Species name	Species status	Population status
1	*Acartia (Acanthacartia) tonsa*	NIS	Established
2	*Acartia (Acartiura) omorii*	NIS	Unknown
3	*Acipenser baeri*	NIS	Not established
4	*Acipenser gueldenstaedtii*	CS	Not established
5	*Acipenser ruthenus*	CS	Unknown
6	*Acipenser transmontanus*	NIS	Not established
7	*Acrochaetium catenulatum*	NIS	Established
8	*Acrochaetium savianum*	NIS	Not established
9	*Aeromonas salmonicida salmonicida*	CS	Established
10	*Agardhiella subulata*	NIS	Established
11	*Aglaothamnion feldmanniae*	CS	Unknown
12	*Aglaothamnion halliae*	NIS	Established
13	*Alexandrium leei*	NIS	Established
14	*Alexandrium minutum*	NIS	Established
15	*Alexandrium tamarense*	CS	Established
16	*Alitta succinea*	CS	Unknown
17	*Alitta virens*	NIS	Established
18	*Alkmaria romijni*	CS	Established
19	*Ameira divagans divagans*	CS	Unknown
20	*Ammothea hilgendorfi*	NIS	Established
21	*Amphibalanus eburneus*	NIS	Not established
22	*Amphibalanus improvisus*	NIS	Established
23	*Amphibalanus reticulatus*	NIS	Unknown
24	*Amphibalanus variegatus*	NIS	Unknown
25	*Anguillicoloides crassus*	NIS	Established
26	*Anotrichium furcellatum*	NIS	Not established
27	*Antithamnion nipponicum*	NIS	Unknown
28	*Antithamnionella spirographidis*	NIS	Established
29	*Antithamnionella ternifolia*	NIS	Established
30	*Aphelochaeta marioni*	CS	Established
31	*Aplidium glabrum*	NIS	Established
32	*Asparagopsis armata*	NIS	Established
33	*Asperococcus scaber*	NIS	Unknown
34	*Atrina rigida*	NIS	Not established
35	*Atyaephyra desmaresti*	NIS	Established
36	*Auriculinella bidentata*	CS	Not established
37	*Austrominius modestus*	NIS	Established

38	*Balanus amphitrite*	NIS	Unknown
39	*Balanus trigonus*	NIS	Unknown
40	*Bellamya chinensis*	NIS	Unknown
41	*Boccardia proboscidea*	NIS	Unknown
42	*Boccardiella ligerica*	CS	Established
43	*Bonamia ostreae*	NIS	Established
44	*Bonnemaisonia hamifera*	NIS	Established
45	*Botrylloides violaceus*	NIS	Established
46	*Botrytella sp.*	NIS	Established
47	*Bougainvillia macloviana*	NIS	Not established
48	*Bougainvillia rugosa*	NIS	Not established
49	*Bowerbankia gracilis*	CS	Unknown
50	*Branchiura sowerbyi*	NIS	Established
51	*Bugula neritina*	NIS	Established
52	*Bugula simplex*	NIS	Established
53	*Bugula stolonifera*	NIS	Established
54	*Callinectes sapidus*	NIS	Established
55	*Caprella mutica*	NIS	Established
56	*Caulacanthus ustulatus*	NIS	Unknown
57	*Celtodoryx ciocalyptoides*	CS	Unknown
58	*Ceramium cimbricum*	CS	Established
59	*Cereus pedunculatus*	NIS	Not established
60	*Chaetoceros peruvianus*	NIS	Established
61	*Chalinula loosanoffi*	NIS	Established
62	*Chattonella marina*	NIS	Established
63	*Chattonella marina var. antiqua*	NIS	Unknown
64	*Chelicorophium curvispinum*	NIS	Established
65	*Chelicorophium robustum*	NIS	Established
66	*Claviceps purpurea*	NIS	Established
67	*Clymenella torquata*	NIS	Established
68	*Codium fragile*	NIS	Established
69	*Codium fragile atlanticum*	NIS	Established
70	*Codium fragile fragile*	NIS	Established
71	*Codium fragile scandinavicum*	NIS	Established
72	*Colpomenia peregrina*	NIS	Established
73	*Conchoderma auritum*	NIS	Unknown
74	*Congeria leucophaeta leucophaeta*	CS	Not established
75	*Corambe obscura*	NIS	Not established
76	*Corbicula fluminea*	NIS	Established
77	*Cordylophora caspia*	NIS	Established
78	*Corella eumyota*	NIS	Established

79	*Corophium curvispinum*	NIS	Established
80	*Corynophlaea verruculiformis*	NIS	Established
81	*Coscinodiscus wailesii*	NIS	Established
82	*Cotula coronopifolia*	NIS	Established
83	*Craspedacusta sowerbii*	NIS	Established
84	*Crassostrea angulata*	CS	Not established
85	*Crassostrea gigas*	NIS	Established
86	*Crassostrea virginica*	NIS	Unknown
87	*Crepidula fornicata*	NIS	Established
88	*Cryptonemia hibernica*	NIS	Unknown
89	*Dasya baillouviana*	NIS	Established
90	*Desdemona ornata*	NIS	Unknown
91	*Devaleraea ramentacea*	NIS	Unknown
92	*Diadumene cincta*	NIS	Established
93	*Diadumene lineata*	NIS	Unknown
94	*Dicroerisma psilonereiella*	NIS	Not established
95	*Didemnum vexillum*	NIS	Established
96	*Dikerogammarus haemobaphes*	NIS	Unknown
97	*Dikerogammarus villosus*	NIS	Established
98	*Dissodinium pseudocalani*	NIS	Not established
99	*Dreissena bugensis*	NIS	Established
100	*Dreissena polymorpha*	NIS	Established
101	*Dugesia tigrina*	NIS	Established
102	*Edwardsiella lineata*	NIS	Established
103	*Elachista sp.*	NIS	Established
104	*Elodea nuttallii*	NIS	Established
105	*Ensis directus*	NIS	Established
106	*Eriocheir sinensis*	NIS	Established
107	*Eucampia cornuta*	CS	Unknown
108	*Eucheilota menoni*	NIS	Unknown
109	*Euplana gracilis*	NIS	Unknown
110	*Euplokamis dunlapae*	NIS	Established
111	*Eurytemora americana*	NIS	Established
112	*Eusarsiella zostericola*	NIS	Established
113	*Fenestrulina delicia*	CS	Established
114	*Ferrisia wautieri*	CS	Not established
115	*Fibrocapsa japonica*	NIS	Established
116	*Ficopomatus enigmaticus*	NIS	Established
117	*Fucus distichus*	CS	Unknown
118	*Fucus evanescens*	NIS	Established
119	*Gammarus tigrinus*	NIS	Established

120	*Garveia franciscana*	NIS	Established
121	*Gibbula ardens*	NIS	Unknown
122	*Goneplax rhomboides*	NIS	Established
123	*Gonionemus vertens*	NIS	Established
124	*Gracilaria gracilis*	CS	Established
125	*Gracilaria vermiculophylla*	NIS	Established
126	*Grandidierella japonica*	NIS	Unknown
127	*Grateloupia luxurians*	NIS	Unknown
128	*Grateloupia turuturu*	NIS	Established
129	*Gymnodinium aureolum*	NIS	Unknown
130	*Gymnodinium catenatum*	CS	Established
131	*Gyrodactylus salaris*	NIS	Established
132	*Gyrodinium corallinum*	NIS	Established
133	*Haplosporidium armoricanum*	NIS	Unknown
134	*Hemigrapsus penicillatus*	NIS	Established
135	*Hemigrapsus sanguineus*	NIS	Established
136	*Hemigrapsus takanoi*	NIS	Established
137	*Hemimysis anomala*	NIS	Established
138	*Heterosigma akashiwo*	NIS	Established
139	*Heterosigma carterae*	CS	Unknown
140	*Heterosiphonia japonica*	NIS	Established
141	*Hexaplex (Trunculariopsis) trunculus*	NIS	Not established
142	*Homarus americanus*	NIS	Unknown
143	*Hydroides dianthus*	NIS	Unknown
144	*Hydroides elegans*	NIS	Unknown
145	*Hydroides ezoensis*	NIS	Unknown
146	*Hypania invalida*	NIS	Established
147	*Hypophthalmichthys molitrix*	NIS	Established
148	*Ianiropsis tridens*	NIS	Established
149	*Imogine necopinata*	CS	Unknown
150	*Incisocalliope aestuarius*	NIS	Established
151	*Jaera istri*	NIS	Established
152	*Jassa marmorata*	CS	Established
153	*Karenia mikimotoi*	NIS	Established
154	*Karlodinium veneficum*	CS	Unknown
155	*Labyrinthula zosterae*	CS	Established
156	*Laonome calida*	NIS	Unknown
157	*Lepomis gibbosus*	NIS	Unknown
158	*Limnoria quadripunctata*	CS	Unknown
159	*Limnoria tripunctata*	CS	Unknown
160	*Limulus polyphemus*	NIS	Not established

161	*Litosiphon laminariae*	CS	Unknown
162	*Lomentaria hakodatensis*	CS	Established
163	*Ludwigia grandiflora (Michx.)*	NIS	Unknown
164	*Marenzelleria neglecta*	NIS	Established
165	*Marenzelleria viridis*	NIS	Established
166	*Marphysa sanguinea*	NIS	Unknown
167	*Marsupenaeus japonicus*	NIS	Not established
168	*Marteilia refringens*	NIS	Not established
169	*Mediopyxis helysia*	NIS	Established
170	*Megabalanus coccopoma*	NIS	Not established
171	*Megabalanus tintinnabulum*	NIS	Unknown
172	*Melita nitida*	NIS	Established
173	*Mercenaria mercenaria*	NIS	Unknown
174	*Microphthalmus similis*	CS	Established
175	*Micropogonias undulatus*	NIS	Unknown
176	*Micropterus dolomieu*	NIS	Not established
177	*Mnemiopsis leidyi*	NIS	Established
178	*Moerisia inkermanica*	NIS	Not established
179	*Molgula manhattensis*	NIS	Established
180	*Monocorophium sextonae*	CS	Established
181	*Monocorophium uenoi*	NIS	Unknown
182	*Morone saxatilis*	NIS	Not established
183	*Mya arenaria*	CS	Established
184	*Mycale (Carmia) micracanthoxea*	CS	Established
185	*Myicola ostreae*	NIS	Unknown
186	*Myriactula sp.*	NIS	Established
187	*Mytilicola intestinalis*	CS	Established
188	*Mytilicola orientalis*	NIS	Established
189	*Mytilopsis leucophaeata*	NIS	Established
190	*Mytilus galloprovincialis*	CS	Unknown
191	*Nassarius corniculum*	NIS	Unknown
192	*Necora puber*	NIS	Not established
193	*Nemopsis bachei*	NIS	Established
194	*Neodexiospira brasiliensis*	NIS	Unknown
195	*Neogobius fluviatilis*	NIS	Unknown
196	*Neogobius kessleri*	NIS	Unknown
197	*Neogobius melanostomus*	NIS	Established
198	*Neosiphonia harveyi*	NIS	Established
199	*Obesogammarus crassus*	NIS	Established
200	*Ocenebra erinaceus*	NIS	Not established
201	*Ocenebra inornata*	NIS	Established

202	*Odontella sinensis*	NIS	Established
203	*Oithona davisae*	NIS	Established
204	*Onchocleidus dispar*	NIS	Unknown
205	*Oncorhynchus clarkii*	NIS	Unknown
206	*Oncorhynchus gorbuscha*	NIS	Not established
207	*Oncorhynchus kisutch*	NIS	Not established
208	*Oncorhynchus mykiss*	NIS	Established
209	*Orconectes virilis*	NIS	Unknown
210	*Oreochromis niloticus niloticus*	NIS	Not established
211	*Ostracoblabe implexa*	CS	Unknown
212	*Oxytoxum criophilum*	NIS	Established
213	*Pachycordyle navis*	CS	Established
214	*Palaemon macrodactylus*	NIS	Established
215	*Paralaeospira malardi*	CS	Unknown
216	*Paranais botniensis*	NIS	Unknown
217	*Penilia avirostris*	NIS	Established
218	*Peridinium quinquecorne*	NIS	Established
219	*Perophora japonica*	NIS	Established
220	*Petricolaria pholadiformis*	NIS	Established
221	*Pfiesteria piscicida*	CS	Unknown
222	*Pfiesteria shumwayae*	CS	Unknown
223	*Physella acuta*	NIS	Established
224	*Pikea californica*	NIS	Unknown
225	*Pileolaria berkeleyana*	NIS	Established
226	*Pileolaria militaris*	NIS	Unknown
227	*Pilumnus hirtellus*	NIS	Not established
228	*Pinctada imbricata radiata*	NIS	Unknown
229	*Platorchestia platensis*	NIS	Established
230	*Pleurosigma simonsenii*	NIS	Not established
231	*Poecilia reticulata*	NIS	Unknown
232	*Polydora ciliata*	CS	Established
233	*Polysiphonia senticulosa*	NIS	Established
234	*Potamopyrgus antipodarum*	NIS	Established
235	*Proasellus coxalis*	NIS	Established
236	*Procambarus fallax f. virginalis*	NIS	Established
237	*Proceraea cornuta*	NIS	Unknown
238	*Prorocentrum cordatum*	CS	Established
239	*Prorocentrum triestinum*	NIS	Established
240	*Pseudobacciger harengulae*	NIS	Established
241	*Pseudochattonella verruculosa*	NIS	Established
242	*Pseudodactylogyrus anguillae*	NIS	Established

243	*Pseudodactylogyrus bini*	NIS	Unknown
244	*Pseudodiaptomus marinus*	NIS	Established
245	*Pseudolithoderma roscoffense*	CS	Unknown
246	*Psiloteredo megotara*	CS	Unknown
247	*Pteropurpura (Ocinebrellus) inornata*	NIS	Unknown
248	*Pterosiphonia pinnulata*	CS	Unknown
249	*Rangia cuneata*	NIS	Unknown
250	*Rapana venosa*	NIS	Unknown
251	*Rhithropanopeus harrisii*	NIS	Established
252	*Ruditapes philippinarum*	NIS	Established
253	*Saccharina japonica*	NIS	Not established
254	*Sarcodiotheca gaudichaudii*	NIS	Unknown
255	*Sargassum muticum*	NIS	Established
256	*Schizobrachiella verrilli*	CS	Not established
257	*Scytosiphon dotyi*	CS	Unknown
258	*Sebastes schlegelii*	NIS	Unknown
259	*Sinelobus stanfordi*	NIS	Unknown
260	*Skistodiaptomus pallidus*	NIS	Unknown
261	*Smittoidea prolifica*	NIS	Established
262	*Solidobalanus fallax*	NIS	Unknown
263	*Solieria chordalis*	NIS	Unknown
264	*Solieria filiformis*	CS	Unknown
265	*Spartina townsendii var. anglica*	NIS	Established
266	*Spartina x townsendii*	NIS	Unknown
267	*Sphaerococcus coronopifolius*	CS	Established
268	*Spisula solidissima*	NIS	Unknown
269	*Stephanopyxis palmeriana*	NIS	Unknown
270	*Sternaspis scutata*	CS	Unknown
271	*Styela clava*	NIS	Established
272	*Stylochus flevensis*	CS	Not established
273	*Suberites massa*	CS	Unknown
274	*Sycon scaldiense*	CS	Unknown
275	*Synidotea laticauda*	NIS	Unknown
276	*Telmatogeton japonicus*	NIS	Established
277	*Teredo navalis*	CS	Established
278	*Tetraodon fluviatilis*	NIS	Not established
279	*Thalassiosira punctigera*	NIS	Established
280	*Thalassiosira tealata*	NIS	Established
281	*Thecadinium kofoidii*	NIS	Not established
282	*Thecadinium yashimaense*	NIS	Unknown
283	*Tricellaria inopinata*	NIS	Established

284	*Trinectes maculatus*	NIS	Not established
285	*Tubificoides heterochaetus*	NIS	Unknown
286	*Ulva californica*	CS	Established
287	*Ulva pertusa*	NIS	Established
288	*Umbraulva olivascens*	CS	Unknown
289	*Undaria pinnatifida*	NIS	Established
290	*Urosalpinx cinerea*	NIS	Established
291	*Victorella pavida*	CS	Established
292	*Viviparus acerosus*	NIS	Unknown
293	*Viviparus viviparus*	CS	Established
294	*Watersipora subtorquata*	NIS	Unknown

Bay of Biscay and Iberian Coast

Source: AquaNIS (as per 6. May 2016)

No.	Species name	Species status	Population status
1	*Acartia (Acanthacartia) tonsa*	NIS	Established
2	*Acipenser baeri*	NIS	Not established
3	*Aiptasia pulchella*	NIS	Unknown
4	*Alexandrium leei*	NIS	Unknown
5	*Alexandrium minutum*	CS	Unknown
6	*Alexandrium taylori*	NIS	Unknown
7	*Ampelisca cavicoxa*	NIS	Unknown
8	*Ampelisca heterodactyla*	NIS	Unknown
9	*Amphibalanus amphitrite*	NIS	Established
10	*Amphibalanus eburneus*	NIS	Unknown
11	*Amphibalanus improvisus*	NIS	Established
12	*Anadara diluvii*	CS	Unknown
13	*Anadara kagoshimensis*	NIS	Unknown
14	*Anguillicoloides crassus*	NIS	Unknown
15	*Anomia chinensis*	NIS	Unknown
16	*Anotrichium furcellatum*	NIS	Established
17	*Antithamnion amphigeneum*	NIS	Established
18	*Antithamnion densum*	NIS	Established
19	*Antithamnion nipponicum*	NIS	Not established
20	*Antithamnionella spirographidis*	NIS	Established
21	*Antithamnionella ternifolia*	NIS	Established
22	*Aoroides curvipes*	NIS	Unknown
23	*Aoroides longimerus*	NIS	Unknown
24	*Aoroides semicurvatus*	NIS	Unknown
25	*Artemia franciscana*	NIS	Unknown
26	*Asparagopsis armata*	NIS	Established
27	*Asparagopsis taxiformis*	NIS	Unknown
28	*Austrominius modestus*	NIS	Established
29	*Autonoe spiniventris*	NIS	Unknown
30	*Balanus albicostatus*	NIS	Unknown
31	*Balanus amphitrite*	NIS	Not established
32	*Balanus trigonus*	NIS	Unknown
33	*Bivetiella cancellata*	NIS	Not established
34	*Blackfordia virginica*	CS	Established
35	*Boccardia proboscidea*	NIS	Unknown
36	*Boccardia semibranchiata*	NIS	Established

37	*Bonamia exitiosa*	NIS	Unknown
38	*Bonamia ostreae*	NIS	Established
39	*Bonnemaisonia hamifera*	NIS	Established
40	*Botrylloides violaceus*	NIS	Established
41	*Botryllus schlosseri*	NIS	Established
42	*Brania arminii*	NIS	Unknown
43	*Bugula neritina*	NIS	Established
44	*Bugula stolonifera*	NIS	Established
45	*Bulinus contortus*	NIS	Established
46	*Bythocaris cosmetops*	NIS	Not established
47	*Callinectes sapidus*	NIS	Established
48	*Caprella mutica*	NIS	Unknown
49	*Caprella scaura*	NIS	Established
50	*Carpobrotus acinaciformis*	NIS	Unknown
51	*Caulacanthus ustulatus*	NIS	Unknown
52	*Celleporaria brunnea*	NIS	Unknown
53	*Celtodoryx ciocalyptoides*	CS	Unknown
54	*Centroceras clavulatum*	NIS	Unknown
55	*Chaetopleura angulata*	NIS	Established
56	*Chama gryphoides*	CS	Unknown
57	*Codium adhaerens*	CS	Unknown
58	*Codium fragile fragile*	NIS	Established
59	*Colpomenia peregrina*	NIS	Established
60	*Corbicula fluminalis*	NIS	Established
61	*Corbicula fluminea*	NIS	Established
62	*Cordylophora caspia*	NIS	Established
63	*Corella eumyota*	NIS	Established
64	*Coscinasterias tenuispina*	CS	Established
65	*Crassostrea gigas*	NIS	Established
66	*Crassostrea virginica*	NIS	Unknown
67	*Crepidula fornicata*	NIS	Established
68	*Crepipatella dilatata*	NIS	Unknown
69	*Cyclope neritea*	NIS	Unknown
70	*Dasya sessilis*	NIS	Established
71	*Desdemona ornata*	NIS	Established
72	*Diadumene lineata*	NIS	Unknown
73	*Diamysis bahirensis*	NIS	Unknown
74	*Didemnum sp.*	NIS	Unknown
75	*Dipolydora tentaculata*	NIS	Unknown
76	*Dyspanopeus sayi*	NIS	Unknown
77	*Eichhornia crassipes*	NIS	Unknown

78	*Ensis directus*	NIS	Established
79	*Eocuma dimorphum*	NIS	Unknown
80	*Eriocheir sinensis*	NIS	Established
81	*Eucheilota menoni*	NIS	Unknown
82	*Ficopomatus enigmaticus*	NIS	Established
83	*Fundulus heteroclitus*	NIS	Established
84	*Fusinus rostratus*	NIS	Unknown
85	*Gibbula adansoni*	NIS	Unknown
86	*Gibbula adriatica*	CS	Unknown
87	*Gibbula albida*	NIS	Established
88	*Glycera dayi*	NIS	Unknown
89	*Gonionemus vertens*	NIS	Established
90	*Goniotrichopsis sublittoralis*	NIS	Unknown
91	*Gracilaria vermiculophylla*	NIS	Established
92	*Grandidierella japonica*	NIS	Not established
93	*Grateloupia filicina var. luxurians*	NIS	Established
94	*Grateloupia turuturu*	NIS	Established
95	*Gymnodinium catenatum*	CS	Established
96	*Haminoea japonica*	NIS	Established
97	*Haplosporidium armoricanum*	NIS	Unknown
98	*Hemigrapsus penicillatus*	NIS	Established
99	*Hemigrapsus takanoi*	NIS	Unknown
100	*Heterosiphonia japonica*	NIS	Established
101	*Hexaplex (Trunculariopsis) trunculus*	NIS	Unknown
102	*Homarus americanus*	NIS	Unknown
103	*Jasus lalandii*	NIS	Not established
104	*Karenia mikimotoi*	NIS	Established
105	*Lagocephalus sceleratus*	NIS	Unknown
106	*Limnoperna securis*	NIS	Established
107	*Limnoria quadripunctata*	NIS	Not established
108	*Lomentaria hakodatensis*	NIS	Established
109	*Maeotias marginata*	NIS	Unknown
110	*Marsupenaeus japonicus*	NIS	Established
111	*Marteilia refringens*	NIS	Established
112	*Melita nitida*	NIS	Unknown
113	*Mercenaria mercenaria*	NIS	Not established
114	*Microcosmus squamiger*	CS	Established
115	*Monocorophium acherusicum*	NIS	Unknown
116	*Monocorophium sextonae*	NIS	Unknown
117	*Monophorus perversus*	CS	Unknown
118	*Murex brandardis*	NIS	Unknown

119	*Musculista senhousia*	NIS	Established
120	*Mya arenaria*	CS	Established
121	*Nassarius corniculum*	NIS	Unknown
122	*Nassarius mutabilis*	NIS	Unknown
123	*Nemopsis bachei*	NIS	Unknown
124	*Neosiphonia harveyi*	NIS	Established
125	*Ocenebra inornata*	NIS	Established
126	*Ostrea angasi*	NIS	Unknown
127	*Ostrea denselamellosa*	NIS	Unknown
128	*Ostrea puelchana*	NIS	Unknown
129	*Palaemon macrodactylus*	NIS	Established
130	*Panulirus guttatus*	NIS	Unknown
131	*Paracaprella pusilla*	NIS	Unknown
132	*Paraleucilla magna*	NIS	Unknown
133	*Percnon gibbesi*	NIS	Not established
134	*Perkinsus olseni*	NIS	Established
135	*Petricolaria pholadiformis*	NIS	Unknown
136	*Pikea californica*	CS	Unknown
137	*Porphyra tenera*	CS	Unknown
138	*Potamopyrgus antipodarum*	NIS	Established
139	*Prionospio pulchra*	NIS	Unknown
140	*Pseudo-nitzschia australis*	CS	Unknown
141	*Pseudomyicola spinosus*	NIS	Established
142	*Pseudopolydora paucibranchiata*	NIS	Unknown
143	*Pseudostylochus ostreophagus*	NIS	Unknown
144	*Pteropurpura (Ocinebrellus) inornata*	NIS	Established
145	*Pyrodinium bahamense*	NIS	Unknown
146	*Quinqueloculina carinatastriata*	NIS	Unknown
147	*Rapana venosa*	NIS	Not established
148	*Rhithropanopeus harrisii*	NIS	Established
149	*Ruditapes philippinarum*	NIS	Established
150	*Sargassum muticum*	NIS	Established
151	*Scageliopsis patens*	NIS	Established
152	*Scytosiphon dotyi*	NIS	Unknown
153	*Solidobalanus fallax*	NIS	Unknown
154	*Spartina densiflora*	NIS	Unknown
155	*Spartina patens*	NIS	Established
156	*Spongoclonium caribaeum*	CS	Unknown
157	*Styela clava*	NIS	Established
158	*Styela plicata*	NIS	Established
159	*Symphyocladia marchantioides*	NIS	Established

160	*Synidotea laticauda*	NIS	Unknown
161	*Tellina compressa*	NIS	Unknown
162	*Teredo bartschi*	CS	Unknown
163	*Teredo navalis*	CS	Unknown
164	*Tricellaria inopinata*	NIS	Established
165	*Ulva pertusa*	NIS	Unknown
166	*Undaria pinnatifida*	NIS	Established
167	*Watersipora subtorquata*	NIS	Established
168	*Womersleyella setacea*	NIS	Unknown
169	*Zoobotryon verticillatum*	CS	Unknown

Baltic Sea

Source: Ojaveer, H., Olenin, S., Narščius, A., Florin, A.-B., Ezhova, E., Gollasch, S., Jensen, K.R., Lehtiniemi, M., Minchin, D., Normant-Saremba, M. and Strāke, S. Dynamics of biological invasions and pathways over time: a case study of a temperate coastal sea (Biological Invasions, under review)

No.	Species name	Species status	Population status
1.	*Acartia (Acanthacartia) tonsa*	NIS	Established
2.	*Acipenser baeri*	NIS	Not established
3.	*Acipenser gueldenstaedtii*	NIS	Not established
4.	*Acipenser oxyrinchus*	NIS	Not established
5.	*Acipenser ruthenus*	NIS	Not established
6.	*Acipenser stellatus*	NIS	Not established
7.	*Alitta succinea*	CS	Established
8.	*Alitta virens*	CS	Established
9.	*Alkmaria romijni*	NIS	Established
10.	*Ameira divagans divagans*	CS	Established
11.	*Amphibalanus improvisus*	NIS	Established
12.	*Anguillicoloides crassus*	NIS	Established
13.	*Aristichthys nobilis*	NIS	Not established
14.	*Beroe ovata*	NIS	Not established
15.	*Boccardiella ligerica*	NIS	Established
16.	*Bonnemaisonia hamifera*	NIS	Established
17.	*Bowerbankia gracilis*	CS	Unknown
18.	*Branchiura sowerbyi*	NIS	Not established
19.	*Callinectes sapidus*	NIS	Not established
20.	*Carassius gibelio*	NIS	Established
21.	*Catostomus catostomus*	NIS	Not established
22.	*Cercopagis (Cercopagis) pengoi*	NIS	Established

23.	*Chaetoceros cf. lorenzianus*	CS	Established
24.	*Chaetoceros peruvianus*	NIS	Not established
25.	*Chaetogammarus ischnus*	NIS	Not established
26.	*Chaetogammarus warpachowskyi*	NIS	Established
27.	*Chara connivens*	NIS	Established
28.	*Chelicorophium curvispinum*	NIS	Established
29.	*Cordylophora caspia*	CS	Established
30.	*Coregonus autumnalis*	NIS	Not established
31.	*Coregonus muksun*	NIS	Not established
32.	*Coregonus nasus*	NIS	Not established
33.	*Coregonus peled*	NIS	Not established
34.	*Cornigerius maeoticus*	NIS	Not established
35.	*Coscinodiscus wailesii*	NIS	Unknown
36.	*Crassostrea gigas*	NIS	Not established
37.	*Crassostrea virginica*	NIS	Not established
38.	*Ctenopharyngodon idella*	NIS	Not established
39.	*Cyprinus carpio*	NIS	Established
40.	*Dasya baillouviana*	NIS	Established
41.	*Diadumene lineata*	NIS	Unknown
42.	*Dikerogammarus haemobaphes*	NIS	Established
43.	*Dikerogammarus villosus*	NIS	Established
44.	*Dreissena bugensis*	NIS	Established
45.	*Dreissena polymorpha*	NIS	Established
46.	*Echinogammarus trichiatus*	NIS	Established
47.	*Elodea canadensis*	NIS	Established
48.	*Elodea nuttallii*	NIS	Established
49.	*Ensis directus*	NIS	Established

50.	*Eriocheir sinensis*	NIS	Not established
51.	*Evadne anonyx*	NIS	Established
52.	*Ficopomatus enigmaticus*	NIS	Established
53.	*Fucus evanescens*	CS/NIS	Established
54.	*Gammarus tigrinus*	NIS	Established
55.	*Gmelinoides fasciatus*	NIS	Established
56.	*Gracilaria vermiculophylla*	NIS	Established
57.	*Grandidierella japonica*	NIS	Unknown
58.	*Hemigrapsus sanguineus*	NIS	Established
59.	*Hemigrapsus takanoi*	NIS	Established
60.	*Hemimysis anomala*	NIS	Established
61.	*Homarus americanus*	NIS	Not established
62.	*Huso huso*	NIS	Not established
63.	*Hypania invalida*	NIS	Unknown
64.	*Hypophthalmichthys molitrix*	NIS	Not established
65.	*Hypophthalmichthys nobilis*	NIS	Not established
66.	*Jassa marmorata*	CS	Established
67.	*Karenia mikimotoi*	NIS	Established
68.	*Laonome sp.*	NIS	Established
69.	*Lennoxia faveolata*	CS/NIS	Unknown
70.	*Lepomis gibbosus*	NIS	Not established
71.	*Limnodrilus cervix*	NIS	Unknown
72.	*Limnomysis benedeni*	NIS	Established
73.	*Lithoglyphus naticoides*	NIS	Unknown
74.	*Maeotias marginata*	NIS	Not established
75.	*Marenzelleria arctia*	NIS	Established
76.	*Marenzelleria neglecta*	NIS	Established

77.	*Marenzelleria viridis*	NIS	Established
78.	*Melita nitida*	NIS	Unknown
79.	*Micropterus dolomieu*	NIS	Not established
80.	*Micropterus salmoides*	NIS	Not established
81.	*Mnemiopsis leidyi*	NIS	Established
82.	*Mya arenaria*	CS	Established
83.	*Mytilopsis leucophaeata*	NIS	Established
84.	*Neogobius fluviatilis*	NIS	Not established
85.	*Neogobius melanostomus*	NIS	Established
86.	*Obesogammarus crassus*	NIS	Established
87.	*Odontella sinensis*	NIS	Unknown
88.	*Oncorhynchus gorbuscha*	NIS	Not established
89.	*Oncorhynchus keta*	NIS	Not established
90.	*Oncorhynchus kisutch*	NIS	Not established
91.	*Oncorhynchus mykiss*	NIS	Established
92.	*Oncorhynchus nerka*	NIS	Not established
93.	*Oncorhynchus tshawytscha*	NIS	Not established
94.	*Orchestia cavimana*	CS/NIS	Established
95.	*Orconectes limosus*	NIS	Established
96.	*Pachycordyle navis*	CS	Not established
97.	*Palaemon elegans*	CS	Established
98.	*Palaemon macrodactylus*	NIS	Not established
99.	*Paramysis (Mesomysis) intermedia*	NIS	Established
100.	*Paramysis (Serrapalpisis) lacustris*	NIS	Established
101.	*Paranais frici*	NIS	Established
102.	*Paratenuisentis ambiguus*	NIS	Established
103.	*Penilia avirostris*	NIS	Established

104.	*Perccottus glenii*	NIS	Established
105.	*Peridinium quinquecorne*	NIS	Established
106.	*Petricolaria pholadiformis*	NIS	Established
107.	*Platorchestia platensis*	CS/NIS	Established
108.	*Pontogammarus robustoides*	NIS	Established
109.	*Potamopyrgus antipodarum*	NIS	Established
110.	*Potamothrix bavaricus*	NIS	Unknown
111.	*Potamothrix bedoti*	NIS	Established
112.	*Potamothrix heuscheri*	NIS	Established
113.	*Potamothrix moldaviensis*	NIS	Established
114.	*Potamothrix vejdovskyi*	NIS	Established
115.	*Proasellus coxalis*	NIS	Established
116.	*Prorocentrum cordatum*	CS	Established
117.	*Proterorhinus marmoratus*	NIS	Not established
118.	*Pseudocuma (Stenocuma) graciloides*	NIS	Unknown
119.	*Pseudodactylogyrus anguillae*	NIS	Established
120.	*Pseudodactylogyrus bini*	NIS	Established
121.	*Rangia cuneata*	NIS	Established
122.	*Rhithropanopeus harrisii*	NIS	Established
123.	*Salvelinus fontinalis*	NIS	Not established
124.	*Salvelinus namaycush*	NIS	Not established
125.	*Sargassum muticum*	NIS	Not established
126.	*Sinelobus stanfordi*	NIS	Established
127.	*Spartina townsendii var. anglica*	NIS	Unknown
128.	*Telmatogeton japonicus*	NIS	Established
129.	*Teredo navalis*	CS	Established
130.	*Thalassiosira punctigera*	NIS	Established

131.	*Tubificoides pseudogaster*	NIS	Established
132.	*Victorella pavida*	CS	Established

Annex 6: WGITMO draft resolution for multi-annual ToRs 2017–2019

The **Working Group on Introduction and Transfer of Marine Organisms** (WGITMO), chaired by Cynthia McKenzie, Canada, will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2017	March 13–15, 2017	Woods Hole, MA, USA	Interim report by 15 April 2017 to SSGEPI	
Year 2018			Interim report by Date Month May to SSGEPI	
Year 2019			Final report by Date Month May to SCICOM	

ToR descriptors

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Advance reseach, develop collaborations and address surveyllance and knowledge gaps in issue related to the introduction and transfer of marine organsims, through annual reviews of national/ international activities and responding to advice requests.	Data, information and knowledge collated and synthesised ensures timely update of AquaNIS. This information will be used as an underlying information source for other ToR's, responding to incoming advice requests as well as organising collaboration with other international science organisations (e.g. PICES and CIESM).	1, 25, 27	3 years	Annual resports to ICES. Further develop and advance AquaNIS database, and populate it with new data. Respond to incoming advice requests as requested.
b	Evaluate the impact climate change may have on the introduction and spread of non-indigenous marine organisms, incl. in Arctic environments.	This work will be carried out jointly with WGBOSV. Contributes to SICCME and ICES high-priority action areas 'Arctic research'.e	3, 4,	3 years	Primary publication on the Arctic environment and the spread of non-indigenous species

c	Investigate biofouling as a vector for the introduction and transfer of aquatic organisms on vessels and artificial hard structures, their pressure and impact on the ecosystem with a comparison of prevention or selective mitigation methodologies.	Biofouling has been increasing recognized as an important vector in the introduction and transfer of aquatic organisms. Elements of this work will be carried out jointly with WGBOSV as a comparison vector in invasion pathways. Biofouling is an increasing concern for aquaculture (WGAQUA), energy installations, and coastal development as stressors on coastal environments.	9, 13,	3 years	Input on the general applicability of preventive measures and selective mitigation technologies through technical paper or manuscript submitted to peer-reviewed scientific journal
d	Advance knowledge base to further develope indicators to evaluate the status and impacts of non-indigenous species in marine environments.	The aim is to develop wider knowledge-base to more effectively address several legislative acts related to introductions of non-native species, such as EU IAS Regulation and EU MSFD (D2). Specifically, WGITMO aims to improve/develop metrics and critically evualuate the underlying uncertainties.	9, 13,	3 years	At least one manuscript to be submitted to a peer-reviewed scientific journal
e	Alien Species Alert report for ICES CRR on *Pseudo-nitzschia* sp. complex in Arctic Regions	Expansion of toxic (domoic acid) producing diatoms into Arctic regions and possible effects on foodweb, seabirds and mammals. In collaboration with WGHABD		3 years	Manuscript for Alien Species Alert Report for ICES CRR in year 3

Summary of the Work Plan

Year 1	Working on all ToRs, but with special focus on b, c, and d
Year 2	Working on all ToRs, but with special focus on a, c, and e
Year 3	Report on all ToRs

Supporting information

Priority	The work of the Group forms the scientific basis for essential advice related to the introduction and transfer of marine organisms, particularly non-indigenous species. Consequently, these activities are considered to have a very high priority.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by some 25–35 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	The group will serve as primary respondents to incoming advice requests on various issues relating to introduction and transfer of marine organisms.
Linkages to other committees or groups	There is a very close working relationship with the Working Group on Ballast Water and Other Ship Vectors (WGBOSV). In addition to relevance to 'sectorial' expert groups, such as Biodiversity Science (WGBIODIV), Aquaculture (WGAQUA), Harmful Algae Bloom Dynamics (WGHABD), WGITMO also contributes to Integrated Ecosystem Assessments EG's.
Linkages to other organizations	PICES and CIESM